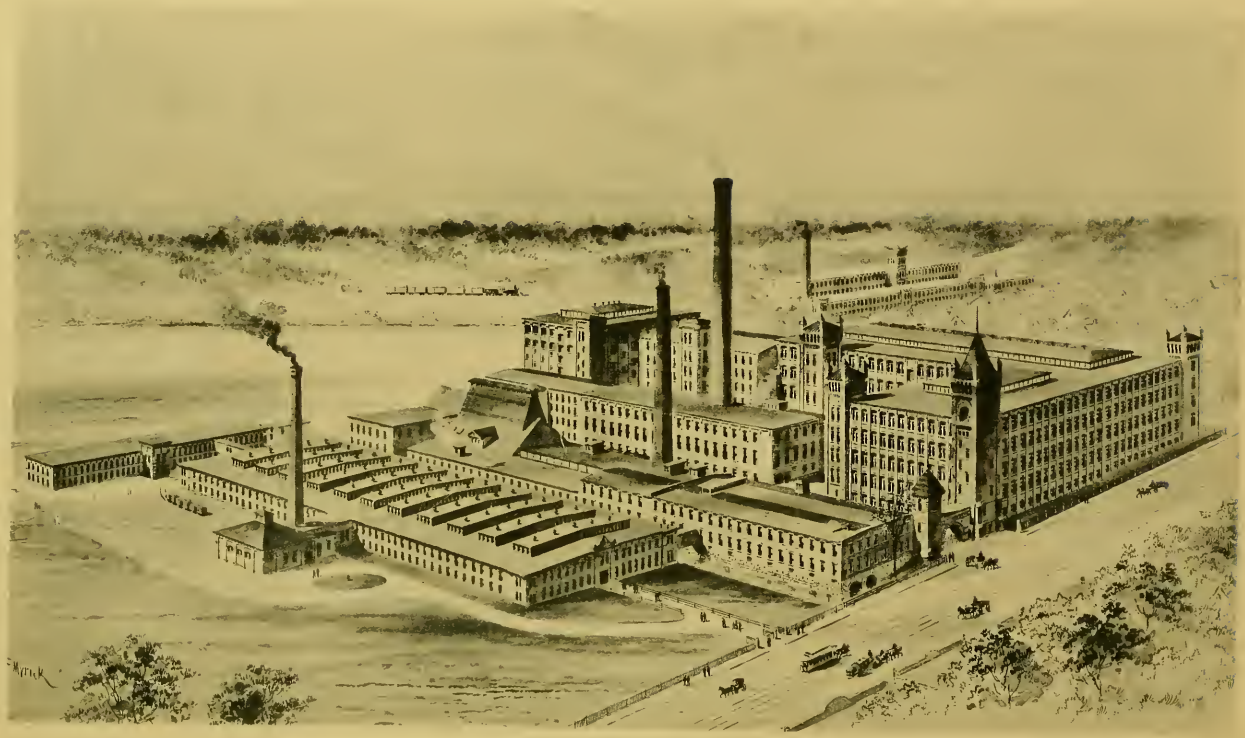

THE ARLINGTON MILLS



ISOMETRIC VIEW OF THE ARLINGTON MILLS—1891.

THE

ARLINGTON MILLS

A Historical and Descriptive Sketch

WITH SOME ACCOUNT

OF THE

WORSTED DRESS-GOODS MANUFACTURE IN THE UNITED STATES

ILLUSTRATED

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THE ARLINGTON MILLS.

I.

THE AMERICAN MANUFACTURER.

THE modern textile factory is the marvel of the age. Here wool as it comes from the sheep's back, and cotton as it is sent from the plantations, begin and finish the journey through which they are transformed into fabrics for the clothing of men and women. In this journey the raw material passes through a succession of manipulations, by the aid of machinery, each of which seems more marvelous than that which precedes it, and all of which the inventive genius of the last century has contributed to revolutionize the textile manufacture of the world. The automatic manufacture of textiles had its origin in Great Britain, where the genius of Kay worked out the fly-shuttle, Crompton invented the mule, Arkwright perfected mechanical spinning, Cartwright devised the power loom, and Lister and Noble and

Evolution of textile manufactures.

others the combing machine; and all of whom share with dozens of others, including very many of our own fellow-citizens, the glory of a transformation the most wonderful in industrial development, and which made Great Britain for more than a century the chief textile manufacturing nation of the world.

Step by step these textile industries have been transplanted to the United States. Under wise and fostering legislation, our people have learned to make their own clothing; and in time, if this legislation continues, our country will supplant Great Britain as the first of manufacturing nations.

Very few of the people who buy and wear cotton and woolen goods have ever seen them made, or have anything save the vaguest conception of the gigantic mills, the wonderful machinery, the multitudinous processes, the remarkable skill, and the large ability required in their fabrication.

In this little book we propose to take our readers through a typical American manufacturing establishment, the Arlington Mills, at Lawrence, Mass., in order that they may learn something of the processes of one of the chief branches of textile manufacture in our own country, — that of worsted dress-goods. We shall record the history of this mill and its growth from a humble beginning into one of the greatest of the American manufactories; we shall describe the numerous structures in which it conducts its operations, enumerate its great variety of products, and afford some insight into the manner in which they are fabricated.

A typical American worsted mill.

In the course of our narrative we shall incidentally recall the earlier history of the dress-goods manufacture in the United States, allude to some of the processes peculiar to it, and describe some of its products, both here and abroad. The technical details of the manufacture we shall touch upon only in the most general manner. The experienced manufacturer wants no description of the operations of any machine he uses, nor of the processes of any part of the manufacture; while the general reader can learn little from such descriptions. Without attempting to be either erudite or exhaustive, we shall seek to make this book something more than the record of the single mill whose name it bears, and a contribution, slight indeed, but intended to be at least accurate, to the history of one of the youngest, yet already one of the most vigorous, of our special textile industries.

Contrast between English and American mills.

The foreign manufacturer, in visiting an American mill, is astonished at the diversity of operations performed in one establishment, nor does he readily comprehend how it can be done so successfully. The custom generally is, in England, for the scouring, the carding, and the combing of the wool to be done by one establishment, the spinning by another, the weaving by another, the dyeing by another, and very often the finishing by still another; while the packing of the goods for the market constitutes another distinct and important branch of business. At the Arlington Mills we find all the processes, both for cotton and for wool, from the sorting of the wool to the boxing and shipping of the goods, conducted not under one

roof exactly, for they require more than a dozen buildings, but under one management, and as the individual parts of the same establishment.

This division of work in the English textile manufacture has a historical origin, which proves it is not an evolution due to its greater economical advantages, as has been frequently claimed for it. The English factory system is a direct evolution from the hand and home industry of the eighteenth century. Both carding and combing were originally carried on in the homes of the work-people. The wool was weighed out to carders or combers by the merchant at the storehouse, and taken to their homes; thence it was returned in the form of tops or card rolls, and again given out to be spun. The yarn was sold to the weavers, who carried their product to the markets on their backs or by pack-horses. At the markets or the inns the merchants bought the cloths, and in turn sold them to the fullers, and in time they reached the shops of the drapers after passing through many hands. The forehanded among all these groups of workers in wool saved their earnings, became employers on a small scale, and many of them were the founders of the great houses which still conduct the manufacture on the basis of its original subdivision. Small capital prevented large enterprises in these early days. But the wool comber, for instance, whose savings permitted him in time to buy his own stock, which he sold in the form of tops, gradually took other combers into his employ, and as machinery came into vogue, he was able to

How the English division of labor began.

A humble origin.

utilize it, still selling his tops to the spinner, who, evolved from the household industry in the same way, still sold his yarn to the weaver; and so on, to the completed fabric. Thus it happens that the so-called English system of subdivision in manufacture grew up from primitive custom, and is the outcome of an economic necessity, rather than a tendency towards subdivision as productive of better results. Indeed the tendency in Great Britain to-day is in the other direction, and towards the consolidation of all the phases of the manufacture under one management. The latest report under the British Factories and Workshop Acts shows that there are now 264 worsted mills in the United Kingdom, with 1,411,327 spinning spindles, where spinning only is done, and 288 establishments devoted wholly to worsted weaving. But there are also 125 establishments, with 931,799 spinning spindles, where spinning and weaving are carried on together; and a comparison of the spinning capacity, with the total number of mills reported in each group, shows that the latter must be much the largest establishments on the average.

The "homespun" industries of America.

The factory system of manufacturing grew up in the United States under circumstances wholly different from those we have been describing. Up to the time of the Revolution, we had no textile manufactures here, save of the household description. Our people wore either "homespun" or imported fabrics. In the meanwhile the factory system was developing with tremendous strides in Great Britain. Realizing what a source of wealth and commercial supremacy it must become, and confi-

dently anticipating that it was England's proud destiny to manufacture the clothing of the entire civilized world, the British Parliament enacted laws which prohibited, under the most stringent penalties, the exportation of textile machines, or any parts or models of them. At the close of the Revolution, when our people began to turn their attention to the industrial development of their country, they found the doors closed and barred against them. They had none of this new machinery, the use of which had already revolutionized textile manufacture, and they had no means of obtaining it. The people of Pawtucket, Rhode Island, appropriately celebrated in October, 1890, the centennial of the establishment of the first cotton factory in the United States equipped with the modern spinning machinery. It came to this country in the brain of Samuel Slater. Machines and models we could not get; but no law could prevent this mechanical genius, who had served a long apprenticeship at the establishment of Jedediah Strutt, the partner of Richard Arkwright, from rebuilding in this country, without models, machines for spinning identical with those he had helped to construct in his English home.

Samuel Slater.

In like manner the Scholfields, who started at Byfield, Massachusetts, in 1794, the first American woolen mill in which the English machinery was used, brought it to the United States in their heads, — reinvented it, so to speak. Thus the textile manufactures, as conducted under the modern factory system, had their beginnings here without any previous preparation or slow evolution such as preceded them in Great Britain.

The Scholfields.

It required capital to embark in the business under these conditions, and at the first the corporate form was a necessity — a number of wealthy men associating themselves together to supply the money needed to build a factory and equip it with this novel and expensive machinery. Naturally, they found it necessary to carry on the business in all its parts. They could not spin wool for others to weave, because there were no others with the capital required for weaving on any extended scale.

This review of the genesis of our textile industries makes it clear why the system of manufacturing, as carried on in the United States, differs so widely, as a rule, from that which, as a rule, prevails in Great Britain. It has thus happened that as individuals have established themselves in the business of wool manufacture, without resorting to the corporate form, they have most frequently carried it on in all its processes, from the fiber to the fabric. The fulling mills, which in the early days were found on nearly every New England stream, for the finishing of the homespun cloths woven in the households, have all disappeared with the upgrowing of our factories; and the carding mills, which were once as common in the villages as the shoe shop and the grocery store, are almost a thing of the past.

The gradual disappearance of primitive methods.

But so recent is their disappearance, that the treasurer of the Arlington Mills (himself not yet fifty years old), where 40,000 worsted spindles are each of them spinning more yarn in a day than the old hand-wheels could turn out in a week, well remembers in his own family the great woolen spinning-wheel which stood in a corner of the kitchen and supplied all the yarn for

the family homespun. In many an attic these wheels may be found to-day. Scarcely two generations have passed since the bulk of our clothing was made on hand machinery, in precisely the manner in which it had been made from the beginning of recorded history.

It may be admitted that under the American system there is not as uniform success in the woolen manufacture as has marked the history of the industry in the land of its chief development. The number of wrecks which have strewn the pathway of progress in the industry is indeed somewhat appalling. It is rare that one man is found equally qualified to supervise each and every one of the several processes in this most difficult and complicated of all manufactures. The English manufacturer, by devoting his attention exclusively to a single branch of the business, such as the spinning or the dyeing, comes to know it thoroughly, and transmits his knowledge from generation to generation, undoubtedly with some gain in economical conditions.

Advantages of the English system.

In his history of the rise and progress of the manufacturing enterprises of Lowell ("Introduction of the Power Loom and Origin of Lowell"), Mr. Nathan Appleton says: "One thing is certain, manufactures cannot be carried on to any great extent in this country in any other manner than by joint-stock companies. A large capital is necessary to success. Individuals possessing sufficient capital will not give themselves up to this pursuit. It is contrary to the genius of the country." The idea here expressed has not always been borne out in the history of Lawrence.

Nathan Appleton quoted.

But the tendency there, at Lowell, at Fall River, at most of the New England manufacturing centers, has been steadily towards concentration in large establishments; and, as a rule, these great corporations have met with quite as uniform success as the mills organized on a smaller basis, and under individual ownership.

The present tendency towards consolidation.

We have seen the general tendency of the country in this respect, in the statistical returns of the State and Federal censuses, from which it appears that while our output of woolen goods is yearly increasing with great rapidity, the number of establishments devoted to this manufacture is slightly decreasing. Experience has certainly proved, in many particular cases, that the best results, both as to the quality of the fabric and the comparative cost of its production, follow from this concentration. Large capital commands great resources; it seizes upon the latest improvements in machinery and method, regardless of cost; it presses forward into new fields not accessible to the competitor of more limited resources.

Large capital necessary.

Fifty years ago the cotton mills of New England averaged less than eight hundred spindles each, and a mill with ten thousand spindles was unknown. To-day we have many mills with five times that number. One set of cards was the usual equipment of the pioneer woolen mill; to-day a mill of that capacity feels the stress of competition with mills which consume in a few hours the wool that would suffice for its year's supply.

As our mills have grown in capacity, they have developed

among us a small body of trained men who act as their general managers, — men in whom enormous powers are necessarily vested, who carry vast responsibilities, and whose success proves the possession of the widest experience, the most varied talents, and the most thorough executive capacity. The range of their duties involves practical experience in the manufacture itself; it involves a knowledge of mercantile business, upon which the successful marketing of the goods depends; it involves large financial ability, for provision must be made for materials far in advance of their use, and goods must be manufactured a year before they can be turned into money again.

Qualifications of the successful manufacturer.

The men who make marked successes in the management and development of great manufacturing establishments in the United States are much rarer than are the successful bank presidents or presidents of colleges, although the world is not apt to hear so much of them, or to think so much of their achievements. The life-work of a Lowell, a Lawrence, or a Bigelow contributed more substantially to the material development of their country than that of many of the men famous in cabinet or senate. It was a knowledge of the unheralded achievements of such bold and far-sighted men which led Voltaire to say that he knew many merchants of Amsterdam of more penetration and administrative ability than Mazarin or Richelieu.

What they have done for the nation.

The qualities of these pioneers in our textile manufactures are repeated in their successors, who are to-day directing

the millions of spindles and the thousands of looms which clothe our people. Only by studying closely the organism of one of these establishments can we realize the wide range of the concerns over which they have jurisdiction. There is hardly any branch of human knowledge that is not called into requisition at one stage or another of this marvelously diversified industry. At the beginning, the highest engineering skill is demanded to create the buildings in which the many branches of the work are to be carried on.

The organism of a great mill.

The location and arrangement of the structures must be planned with reference to the relations of one branch of the manufacture to the others, the utmost economy of power, and its most effective distribution. Then the architect of the woolen factory deals with the nicest problems of his profession, in the construction of the buildings with reference to the bearing of great weights, and the strain and vibration of machinery in incessant motion.

The engineer and the architect.

Then the builder of machinery is called in; and success in the textile manufactures, more largely than in any other branch of manufacturing, depends upon good judgment in the selection of the machinery to be employed. Improvements and modifications of textile machinery are made almost daily. Perfect as this machinery seems to be to him who watches it perform its work with a precision which the human hand seeks in vain to approximate, yet the simplest of all these machines is suscepti-

The selection of machinery.

ble of improvement; and the successful manufacturer is the one who can detect those new inventions which mark a distinct gain either in economy, efficiency, precision, or rapidity of production. Many a manufacturer has wrecked himself by mistakes in equipping his mill.

The raw material.

Then comes the purchase of the raw material, which is drawn from the four quarters of the globe, which presents a greater variety, in quality and characteristics, than any other substance known to man, and which must be selected with special reference to the particular fabric into which it is designed to transform it.

The processes of manufacture.

Then, again, come the skill and experience required to supervise the manipulation of the material thus carefully gathered together. For, while engineering genius has done much in the construction and arrangement of the buildings, and invention has placed machinery so nearly perfect at the command of the manufacturer, there is not a moment, in the whole journey from the fiber to the fabric, when the human oversight is not necessary and when the keenest, practised judgment must not be alert, to detect defects and shortcomings.

Dyeing.

Turn next to the dye-house, where the noble science of chemistry finds its most useful and most inspiring laboratory. Its secrets here reveal themselves to be utilized in the tints and shades, delicate as those of Nature herself, which the manufacturer imprisons in his fabrics. No department of the textile manufacture has advanced more rapidly than this one, and none is bigger with

promise of reward to the workers in it. A quarter of a century ago the brilliant colors and effects which are now obtained from the products of coal-tar were unknown; and the best manufacturers are forever on the watch for novel combinations and effects, which are always making their appearance.

Intimately allied with the dye-house is the designing room; and here comes in an art by itself, giving room for the play of the highest education, the most technical knowledge, and the most artistic temperament. Those who succeed in this department must not only be gifted in taste and in art, but they must also possess a knowledge of the loom itself; they must know exactly how to place each thread to effect an almost infinite variety of combination weaves, through which may be worked out as many different patterns. And thus we come to the final test of the successful manufacturer, in some respects the most crucial of all, the capacity to understand the popular taste, to anticipate its demands, to combine what the people want with what they ought to want, with a degree of skill that will make the goods sell and at the same time make them a credit to the good taste of the makers. Fashion is an exacting goddess to her own devotees; but to the textile manufacturer she is a despot, sudden in whim, fickle as the breeze, relentless as adamant, before whose decrees he must bow, whose freaks he must execute, whose variations he must, if so be it he can, anticipate, or fall by the wayside.

The designing room.

Must study popular taste.

So many-sided, so wide-embracing, so cosmopolitan in its requirements is the business of the successful textile manufacturer! It is little wonder that so many fail in a field so exacting. Success, on any large scale, is possible only with the most perfect system of organization, with concentration of responsibility in the first instance, and its most minute and perfect subdivision from the common center. Under the general manager, and responsible directly to him, are the superintendents of the several great departments of the manufacture, each supreme in his field, each skilled in his specialty, each capable of managing men, and each with sole control over the employment of his assistants. Then come the overseers of the various departments of each branch of the manufacture, — they in their turn having their subordinate aids, and each and every person, from the highest to the lowest, understanding exactly what is required of him or her, and meeting that requirement with that precision of discipline which is necessary to success. To accomplish perfect results in systems so extensive, where success is dependent upon the utmost uniform attention to the minutest details, systems of checks are necessary, so complete in their operation that it will be possible to determine at any moment whether the requisite amount of product is resulting from a given amount of labor in any department, and to locate, without error, the individual responsibility for the slightest defect at any stage of the manufacture.

Perfect organization required.

Certainly no line of work requires for its successful prosecution on a large scale more varied powers of intellect, or makes

more constant demand upon those elements of character which conquer success. Nor is it any wonder that the art of manufacturing becomes absorbing and attractive, by its variety, its risks, and its possibilities. There is no limit to attainment in this field; and success constantly opens new opportunities for the creative intellect engaged in developing this great national industry, the most ancient of all the human arts, and the most beneficent of all, in its relations to the comfort, the happiness, and the prosperity of the whole people.

Possibilities of constant improvement.

II.

HISTORY OF THE ARLINGTON MILLS.

THE Arlington Mills date back only to 1865. The corporation was first known as the Arlington Woolen Mills, the name being changed after the manufacture of worsteds was undertaken. The early history of the enterprise was not unmarked by reverses; but it has probably developed as rapidly as any establishment in the United States that does not antedate it in origin. With its growth has developed a splendid city, — a city that was unknown to the gazetteers of the State as recently as 1845, and one in whose advancing prosperity the Arlington Mills has played a large part.

Origin of the Arlington Mills.

The Arlington Mills are situated on the Spicket river, which the old chroniclers called the Spiggot, about midway between the Merrimac river and the Massachusetts and New Hampshire boundary line. The location places the worsted mill in Lawrence and the cotton mill in Methuen. The Spicket is a narrow and pictu-

The Spicket river.

resque stream, rising in Salem, New Hampshire, and meeting the Merrimac nearly opposite the mouth of the Shawsheen, in Andover. On its way through the town of Methuen it has three falls within the distance of a mile, and dams have been built at each of them, in order to make the power available. The upper dam, where there is a beautiful natural fall of forty feet, is used by the Methuen Company, manufacturers of ticks, denims, and other cotton goods. The middle dam supplies power to the Methuen Woolen Company; while the third, or lower dam, serves the Arlington Mills, the subject of our sketch.

The water-power of the mills.

The original Arlington Mills relied wholly upon its water supply for power, and before the enlargement began, one turbine wheel of about sixty horse-power sufficed to propel all its machinery. Perhaps the most comprehensive idea of the extent of the growth of the Arlington Mills will come to the reader when he reaches the chapters in which its present capacity of over five thousand horse-power is described as compared with the single turbine wheel of 1865.

The corporation was still utilizing about one hundred and twenty horse-power from two turbine wheels, to run a small portion of its spinning machinery, as recently as 1888, when the old wooden mill was torn down. Since that date water-power has only been used to run a portion of the electric-lighting plant, although in the dyeing and finishing departments the water of the Spicket river remains an indispensable adjunct of the manufacture.

The Arlington is one of a chain of manufacturing establishments in Lawrence or immediately contiguous, dependent upon the Spicket for their water, and whose origin is not to be traced to the utilization of the water-power of the Merrimac, by the Essex Manufacturing Company, in 1845, to which the rapid development of Lawrence as a manufacturing center is directly due.

The Essex Manufacturing Company.

The story of the successive steps to utilize the water-power of the Merrimac river is one of the grandest chapters in the history of New England. The men whose names are identified with these enterprises possessed what now seems like prophetic insight into the industrial possibilities which lay hidden in the bosom of that splendid river. It was not alone, nor even chiefly, the possession of her unsurpassed facilities in the way of water-power that made Massachusetts the early home of the textile industries; it was because the Commonwealth was the mother of such sons as Francis C. Lowell, Amos and Abbott Lawrence, Nathan Appleton, Patrick T. Jackson, Kirk Boott, Samuel Batchelder, J. Wiley Edmands, and their associates, the founders of our textile industries, — the men whose achievements impart a luster to her name not surpassed by her statesmen, her scholars, or her poets, — men with the brains to understand what wealth these rivers could be made to create, what splendid cities might spring from their banks, what thousands of people might there earn their livelihood, — men with the courage, the energy, and the skill to convert these river-

The early manufacturers of Massachusetts.

THE ORIGINAL ARLINGTON MILL—1865.

beds into mill-races, and these meadows into teeming cities. Far-sighted as these men of genius and determination were, they could hardly have foreseen what a marvelous growth a half-century would bring to the cities they founded, and which were so appropriately named Lowell and Lawrence, after the men who conceived the enterprises with which these cities originated.[1]

Lowell and Lawrence.

At Lawrence the aggregation of mills includes the Pacific

[1] Mr. J. F. C. Hayes, in his "History of Lawrence," says that immediately after the project of severing the new city from the territory of Andover and Methuen was broached, the suggestion was made in many quarters that the town should take the name of Lawrence, "as a compliment to Hon. Abbott Lawrence, who had done so much for Massachusetts, and this place in particular;" and he continues: —

"On the 13th of January, 1847, a meeting of a considerable number of residents took place at the office of the Essex Company, with a view to an understanding in regard to the name of the new town, to be embodied in a petition to the Legislature for a charter. At the suggestion of Mr. Storrow, the name of Lawrence was agreed upon, not, as the newspaper writers had proposed, as a compliment distinctively to Mr. Abbott Lawrence, but as a token of respect to a family among the most liberal and distinguished in the country. There were then living three members of this family, Amos, Abbott, and Samuel. Of these, Abbott and Samuel were among the most energetic business men of New England, and both more actively engaged in the enterprises here than any others not residents among us. In point of investment the family undoubtedly then had as great an interest in the new town as, we might almost say, all others combined. There was, therefore, a good if not a sufficient reason why the future city should be christened as it was. That it was not the intention to distinguish one over another member of the Lawrence family in the name of the city, we may refer to the distinct impression, 'S. Lawrence, A. Lawrence,' upon a brick in the south-east corner of our City Hall. We leave the reader to define the question whether Amos or Abbott, or both, were intended to be complimented in the impression, 'A. Lawrence.' There is no question that Samuel, who was then agent of the Bay State Corporation, as well as of the Middlesex Mills in Lowell, was included in the compliment."

Mills, the Washington Mills, the Atlantic Cotton Mills, the Pemberton, the Everett, the Lawrence Duck Company, the Russell Paper Mills, the Farwell Bleachery, the Monroe Paper Company, the Bacon Paper Company, Butler & Robinson, Philips & Kunhardt, the Wright Manufacturing Company, and many others. One of the youngest among them, and certainly as remarkable as any in its rapid development, is the Arlington Mills.

As recently as 1830 the site of the Arlington Mills and the now densely populated country adjoining it was farming and meadow lands. But one house stood there in that year, although there is a tradition that a saw mill was located on this spot in the latter part of the last century. The north side of the Spicket river, in its easterly course from Stevens' pond, was the property of Nehemiah Herrick, of Methuen, while that on the south of the river belonged to the Sargent estate. At the date mentioned, Abiel Stevens began to buy lands along the river banks for the purpose of securing water-power to be employed in the manufacture of pianoforte cases, keys, and the like. He acquired sixty or seventy acres of land, and constructed a dam just above Herrick's bridge, by which the old road to Tower Hill crossed the river at the point now covered by the Arlington pond.

The first enterprise on Stevens' pond.

Mr. Stevens built a factory and began business in 1832, making cases for Jacob Chickering, the celebrated pianoforte maker of Boston. In 1848 Mr. Stevens increased his water-power by purchasing and demolishing the Charles Ingalls dam, located a quarter of a mile

Abiel Stevens' factory.

above him on the river, and building a new and higher dam lower down than his original structure. This dam still remains, forming a part of the Arlington Mills dam.

Mr. Stevens' mill was destroyed by fire in 1834; but he immediately rebuilt it, and continued in business until 1856, when he retired with a competence acquired in an honorable and energetic business career.

Subsequent enterprises.

Mr. Stevens' sons, B. A. Stevens, C. K. Stevens, and L. E. Stevens, established the next enterprise in this mill, for the manufacture of fur and wool hats. It did not prove successful, and after two or three years was discontinued.

After a period of idleness, the mill property was transferred, in 1863, to Stephen N. Allen, who at once sold it to the Fibrilia Manufacturing Company, which undertook the manufacture of felted goods. This enterprise was also of brief continuance. The following year the mill was conveyed to the Berkley Mills Corporation, and in 1865 to Robert M. Bailey, and by him in the same year to the Arlington Woolen Mills.

The extensive plant of the Arlington Mills began, therefore, with the old piano-case factory, which was a wooden building, originally one hundred and thirty-five feet long, thirty-five feet wide, and three stories high. A very excellent representation of this original woolen mill is presented.

Incorporation of the Arlington Woolen Mills.

The Arlington Woolen Mills were incorporated in 1865 under the General Statutes of Massachusetts, with a capital stock of $200,000. The first incorporators were Robert M. Bailey, Charles A. Lambard, Joseph

Nickerson, and George C. Bosson. Mr. Bailey was the first president of the corporation, and the first treasurer was Sumner Wheeler.

The corporation began business with the manufacture of fancy shirting flannels and woolen felted fabrics. It was hardly under way before a fire totally destroyed the mill, in October, 1866. The loss was severe, but the proprietors were not discouraged. They at once began the erection of a new mill, which was finished early in the year 1867. This was also a wooden structure, and it is well represented in the picture on the opposite page.

Fire destroys the mill.

The mill of 1867, which was torn down in 1888 to make way for more modern structures, was a fair specimen of the woolen mill of those days, but very different from any of the numerous buildings which have taken its place. The great advance of manufacturing in the United States is nowhere more strikingly illustrated than in the improved buildings in which it is now conducted; and nowhere is this improvement shown to better advantage than at the Arlington Mills.

Modern improvements in factory construction.

The new mills of the Arlington corporation are all built of brick, and constructed on the most approved plans of modern mill architecture. Throughout each building the system of construction which is described as slow burning is rigidly adhered to. The stairways are located in towers, which recur at convenient intervals; and here also are placed the closets for the use of the help,

Slow burning construction.

THE SECOND ARLINGTON MILL—1867.

in which the most recent methods of sanitation are utilized. Monitor windows adorn nearly every roof, making the rooms below as light as the open, while huge windows, set close together and extending nearly to the ceiling, allow brick walls to exclude as little as possible of the precious daylight.

The heating of these vast structures is done by means of large fans, which blow the air through underground ducts and over hot steam coils into the several rooms. Each of the two large fans devoted to this purpose is capable of forcing 90,000 cubic feet of air a minute through six-foot ducts. The great advantage of this method of heating is the constant change of air which results, thus insuring perfect ventilation. Of course all this is an extraordinary advance over the old factory days, when the only method of heating was by the closed stove, which compelled the breathing of the same air over and over again. The modern manufacturer has come to recognize that everything which contributes to the physical and mental comfort of the operatives pays a good return on its cost, and is therefore a good investment, independently of all philanthropic considerations. So general has been the recognition of this fact, that Colonel Wright says, in one of his reports, that the air in our cotton factories is better than in our lecture rooms.

Fire-escapes, fire pumps, hose, and other precautions against fire are everywhere found. Fire could make no considerable headway in any department before discovery; and the system of automatic sprinklers, in use in all the recently constructed buildings where there is considerable machinery, affords an additional safeguard.

The precautions against fire do not end here, by any means. About ten years ago a portion of the operatives of the mill were organized into "The Arlington Worsted Mills Hose Company," and they constitute an effective fire brigade, ready for an instant emergency. The company consists of not less than twenty-five members, with the Superintendent as presiding officer, and a chief engineer who is the master mechanic of the mills. The brigade has regular drills, and both hose and hydrants are inspected at stated intervals. An officer of the company makes monthly inspections, to see that the spanners and hose are in their places, the fire pails filled, and the fire pumps in good working order.

The Arlington fire brigade.

In addition to the fire brigade is a system of fire alarm. By pressing a button in the room where a fire may start, the location of the fire is instantly communicated to the signal tower, and from that point the number of the room is made known to the members of the fire brigade.

The fire-alarm system.

Some other advances in the way of facilities and improvements may be alluded to in this connection. In 1882 the first Edison lights were placed in the mill, — as early, probably, as in any New England mill; and the system of electric lighting has been gradually extended to the entire establishment. The electricity is supplied by ten arc and three incandescent dynamos of the most modern pattern, and four additional arc dynamos are about to be added. At a moment's notice, thousands of brilliant lights drive the gathering twilight from every nook and corner.

Electric lighting.

The fifty arc lights with which the system began are now extended to five hundred and twenty-four arc lights, which number will soon be increased by two hundred more. There are in addition over one thousand two hundred incandescent lights in the worsted mills, and five hundred and fifty in the cotton mills.

It is related in the mills that a few weeks after the electric lights were introduced, some accident to the machinery compelled a brief return to gas jets. At once the operatives began to complain that they could not see to do their work, and that they could not be responsible for its character, with the insufficient lighting of gas. So great are our advances, that the old methods seem to be utterly inadequate, even before they are fairly dispensed with!

Another illustration of the gain through electricity appears in the utilization of the telephone by the Arlington Mills.

The telephone exchange.

How they ever got along without it is now the mystery to those whose tireless messenger it has become. The mills have their own telephone exchange system, and an expert is kept constantly busy making the connections for the forty-five telephones that connect as many different rooms or departments, each with every other, through the central station. It is a matter of a few moments' time to send a message to every part of the vast establishment. An hour was frequently required to transmit intelligence that now penetrates anywhere in a moment. It is by savings of this kind that great establishments are able to constantly reduce the cost of production; for time

is money, in a mill like this, more literally, perhaps, than anywhere else in the world. The system of long distance telephone wires now connects the Boston office of the Arlington Mills with the mills themselves, and with the office of the selling agents in New York; so that the treasurer sitting at his desk can communicate instantly with either the mill or the market. What else electricity has in store for textile manufacture, we can only imagine as yet; but it is safe to predict that before another decade passes, it will have wrought even greater changes than those just noted.

The rebuilding of the Arlington Woolen Mills in 1866 occurred at a time of great activity in the woolen manufacture of the United States. The tariff of 1867 soon after went into effect. Under this tariff the worsted industry, heretofore carried on in this country under great discouragements and with unsatisfactory results, promised large rewards to those who were bold and enterprising enough to undertake it.

The worsted manufacture in the United States.

The Arlington now embarked in the manufacture of women's worsted and cotton dress-goods. In April, 1867, the capital stock was increased to $240,000. This was done by marking down the two thousand shares, whose par value was one hundred dollars, to eighty dollars, and issuing one thousand additional shares at the latter value, thus making the total of $240,000. The mill was at once equipped with one hundred and sixty looms, and the necessary machinery for the spinning of worsted yarns. For a time the corporation

Worsted dress-goods first made.

encountered great and apparently insurmountable difficulties. The manufacture was altogether new in this country, while it had been brought to a state of high perfection abroad. The experience, the skill, and the capital of the best manufacturers of England, France, and Belgium were busy in its development, while ours were sinking money in costly experiments. Pioneers less courageous and determined would have been disheartened on discovering, as did the proprietors of the Arlington Mills at the close of the year 1869, that the financial condition of the corporation was such as to compel reorganization. But the stockholders met the requirements of the situation, and paid into the treasury the whole amount of the capital stock, $240,000, to make the same good, and still pressed on in the path they had marked out.

Reorganization necessary.

In 1867 Mr. William Whitman was elected treasurer of the corporation, a position which he resigned in June, 1869, when he was succeeded by Mr. B. L. Merrill. But when the capital stock of the company was made good, in December of the latter year, as stated above, an entire reorganization of the management was effected. Mr. Joseph Nickerson, of Boston, was elected president, and Mr. Whitman was again invited to become its treasurer; and he still continues in the management of the corporation to which he was last elected twenty-one years ago.

Mr. Nickerson continued to act as president until his death, which occurred February 29, 1880. He was a man of exceptional business capacity and of marked individuality of char-

acter. A native of Cape Cod, he took naturally to a seafaring life, early rose to the command of a ship, and soon became the owner of ships. Later he embarked in business in Boston as a ship chandler, and afterwards became a manufacturer of cordage and cotton-duck, which enterprise he carried on in connection with the management of ships. With the decline of American shipping, Captain Nickerson transferred his capital and enterprise to railroading. His success in this new field was so marked that at the time of his death he was one of the wealthiest citizens of Boston. Under an exterior sometimes rough, Mr. Nickerson carried one of the kindest of hearts, and conspicuous among his virtues were his undaunted courage and his devoted loyalty to his friends. He was a man cast in a large mould — one born to command. His was one of those strong and forcible natures upon which weaker ones lean in an emergency, and to whom leadership is naturally and voluntarily assigned.

Capt. Joseph Nickerson.

Captain Nickerson was succeeded in the presidency of the Arlington Mills corporation by his son, Mr. Albert Winslow Nickerson, who still discharges the duties of that office.

The work of remodeling the Arlington Mills and increasing its productive capacity was warranted by the healthy prosperity that followed the reorganization of the corporation. It was entered upon in earnest in 1871. New buildings were rapidly constructed and new machinery added, until, in 1877, there were five hundred and eight looms in regular operation, producing

The enlargement of the mills.

five million yards of cloth annually, and giving employment to six hundred operatives.

In the meanwhile an act of the Legislature, in 1875, had changed the title of the company to the Arlington Mills. The capital stock of the corporation was increased to $320,000 in 1876, and in May, 1877, it was still further increased to $500,000. The rapid development of the enterprise in subsequent years is shown by the several additional increases in its capital which have been authorized by the Legislature. In May, 1881, the capital stock was increased to $700,000; in January, 1883, to $1,000,000; in February, 1887, to $1,500,000; and in March, 1890, to $2,000,000. The funds secured by these increases in the capital stock were utilized in paying for very extensive changes and enlargements in the plant, which will be hereafter described. The corporation began to pay dividends in 1877, and has since continued them semi-annually without interruption, the dates of payment being June 30 and December 31.

The several increases in capital stock.

The stock of the corporation is divided into twenty thousand shares, and the stockholders are represented in the management by a board of five directors, annually elected. This board at present consists of Albert W. Nickerson, William A. Russell, George A. Nickerson, Charles C. Burr, and William Whitman. Unlike the directors of many of our large manufacturing corporations, those of the Arlington Mills own in their own right nearly one-half of its capital stock. Their chief executive officer is the treasurer, Mr. Whitman, who is charged with the

Board of directors.

general management of all the affairs of the corporation. Next to him in the management is the resident agent. Mr. Robert Redford was appointed to this responsible position in September, 1888, after serving for eight years as superintendent of the cotton mills. Mr. Redford took charge of the cotton mills at the time of their erection, coming to the United States for that purpose. He had had ten years' experience as superintendent of the Reddish Spinning Mills, near Manchester, England.

The executive management.

The Boston office of the Arlington Mills is located in the new Nevins building, 78 Chauncy street, corner Rowe place, to which point it was removed from 202 Devonshire street, on December 1, 1890. The Boston office of the commission house of Harding, Whitman & Co. is located in the same building.

The Boston office.

The original selling agents of the Arlington Mills was the firm of R. M. Bailey & Co., located on Devonshire street, Boston, Mr. Bailey being one of the original stockholders of the corporation and its first president. Mr. William Whitman, the treasurer of the mills, was connected with the house of R. M. Bailey & Co. at the time, and when the selling agency was transferred, in 1869, to John S. & Eben Wright & Co., of Devonshire street, Boston, Mr. Whitman also went to that firm. Prior to his connection with R. M. Bailey & Co., Mr. Whitman had been for eleven years with the old firm of J. M. Beebe & Co. Wright & Co. retained the agency but a few months, this being the period during which the corporation was

Selling agents.

undergoing reorganization. The goods were sold from December, 1869, to April, 1883, by Lawrence & Co. When the latter house succeeded to the business of James L. Little & Co. they succeeded also to the agency of the Pacific Mills, and the goods of the latter requiring their whole attention, the firm of Brown, Wood & Kingman became the selling agents of the Arlington Mills. It continued to hold this relation until it went out of business, in 1887. The firm of Harding, Colby & Co., whose New York office was located at 80 and 82 Leonard street, then became the selling agents of the mills, Mr. Whitman at the same time becoming a member of the firm. In June, 1889, Mr. Colby died, and in December of that year the firm was dissolved, and the present firm of Harding, Whitman & Co. organized on January 1, 1890.

Harding, Whitman & Co.

With this rapid sketch of the origin, the early vicissitudes, and the subsequent development of the Arlington Mills, we will proceed in another chapter to a more minute description of the property of the corporation as it stands to-day.

III.

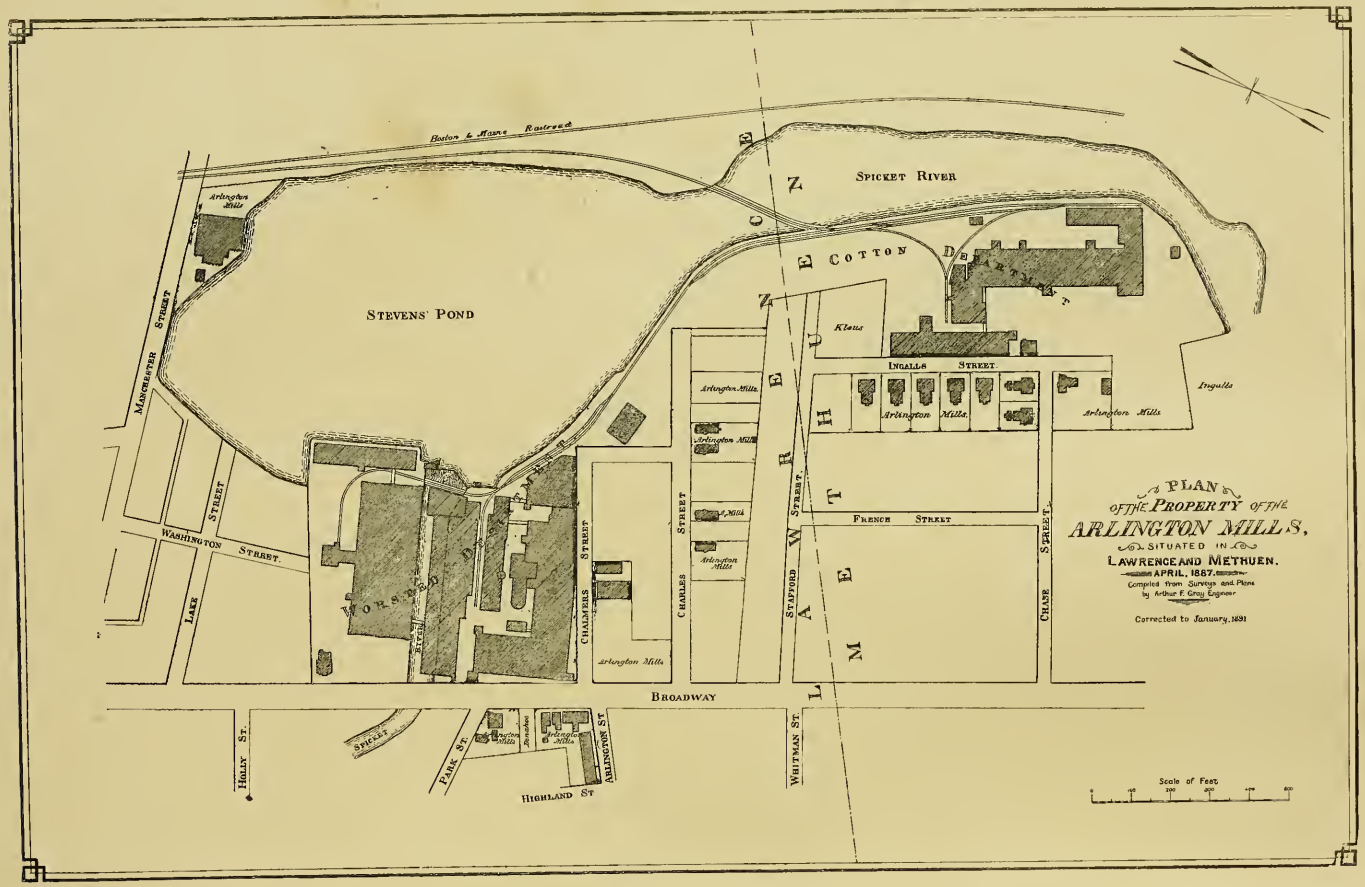
DESCRIPTION OF THE ARLINGTON MILLS.

IT will be interesting to trace more in detail the evolution of the Arlington Mills, from the piano-case factory, which it occupied in 1865, to the dozen magnificent structures, having a floor surface of fully twenty acres, in which its manufacturing is conducted to-day.

The worsted and cotton mills really comprise two distinct and separate establishments, the property of the same corporation, but each under separate superintendence, with separate accounts and pay-rolls, and each independent of the other in power and in equipment as well as in location.

General views of the mills.

The best impression of the plan of the Arlington Mills, and the situation of the several buildings with respect to each other, can be obtained by a study of the isometric picture which forms the frontispiece of this volume, and also the engineer's plan, which appears on the opposite page. These two illustrations are supple-



GROUND PLAN OF ARLINGTON MILLS 1891.

mented with views of the worsted plant and the cotton mills, as they appear from the hillside on the opposite bank of Stevens' pond. This view is as beautiful and inspiring a sight as one can encounter in a day's journey. The panorama tells the story of the source of New England's material advance, and of her prosperous, contented, and intelligent people. Pretty and extensive as these pictures are, they still convey a most inadequate idea of the extent of the Arlington Mills; for the camera of the artist can find no point of view that will present all of the buildings, which are crowded into a space so compact that they seem to grow out of each other.

Before entering the mill proper, we will introduce our readers to the commodious offices of the worsted plant, on Broadway.

The offices of the worsted mill.

They are three in number, and have been recently rearranged and remodeled for the convenience of their occupants and the expeditious despatch of the multitudinous details of the business. Here we shall be welcomed by Mr. Robert Redford, the resident agent of the Arlington Mills, and also by Mr. William D. Hartshorne, the superintendent of the worsted mill, and the assistant superintendent, Mr. George L. Selden. Mr. Hartshorne has been in charge of the worsted mills since 1882,

Superintendent Hartshorne.

coming into its superintendence after a thorough training as a civil engineer, and a previous experience in the dress-goods department of the Arlington Mills. Mr. Hartshorne is as busy a man as may be found in Lawrence, and the various branches of the great worsted mills move on like clock-work under his constant oversight. Catching

him at a moment of unaccustomed leisure, we will accompany him in a tour of the worsted plant of the Arlington Mills.

These buildings, devoted to worsted spinning, weaving, dyeing, and finishing, are situated on what was formerly known as the turnpike stage road to Concord, New Hampshire, now known as Broadway. The buildings are bounded on the north by Chalmers street, and on the west by Stevens' pond. The outlet of this pond, Spicket river, runs in an easterly direction through the worsted plant, leaving nearly two-thirds of the plant to the north of the river, the weave-shed and several other buildings being located to the south.

Location of the worsted mills.

Superintendent Hartshorne will take us first to the boiler and engine houses, in order that we may start on our tour with an intelligent appreciation of the motive power required to keep the thousands of wheels and pulleys and shafts in motion, that in turn give motion to other thousands of spindles and bobbins, looms and warping beams, and the whole myriad mechanism of the mill.

The main boiler-house is situated near the center of the yard, and was built in 1888. It is located chiefly underground, an arrangement which permits the coal to be delivered to bunkers on a level with the floor of the boiler-house, by dumping directly from the yard track overhead.

The boiler-house.

This boiler-house is 150 by 50 feet in dimensions. It contains boilers with a nominal capacity of 2,800 horse-power, but capable of evaporating with ease 150,000 pounds of water per

hour, — sufficient to supply all the steam required for power, dyeing, finishing, heating, and lighting. Directly over the boiler-house has been constructed a two-story building, devoted to the machine and carpenter shops, where every facility exists for keeping the machinery of the mill in repair without loss of time.

The engine-house.

Contiguous to the boiler-house is the engine-house, which consists practically of one room, commodious, well lighted, and shining with polished brass. This room contains two pairs of large Corliss engines, whose capacity is about 3,200 horse-power. In reserve also is a pair of Armington & Sims' engines, with a capacity of 500 horse-power. One pair of engines, in operation since the building was erected, is arranged so that steam can be condensed, either from both cylinders or only from one, according to the demands of the dye-house for exhaust steam from the other. Indeed, this subdivision of the use of exhaust steam can be carried to the extent of the use of either end of either cylinder, — one or all of them. The dimensions are such that choice can be made between the end of a 28-inch cylinder or a 32-inch cylinder, or a multiple of them.

The weights of some of the parts of these engines convey an idea of their size and power. For instance, the main pulley or fly-wheels of each pair weighs nearly 84,000 pounds, and the two 48-inch cylinders in the new pair weigh 21,000 pounds each. The shipping weight of the smallest pair of engines was 200,000 pounds.

These fly-wheels are 27 feet in diameter, with faces of 109

inches and 110 inches respectively. One of them drives five 20-inch belts, and the other two 40-inch belts and one 25½-inch belt. At 6.10 every working morning these beautiful, great fly-wheels slowly begin the revolutions, like giants preparing for battle, to which thousands of wheels respond like clock-work, for the labor of the day.

The engines and boilers above described supply power only for the spinning mills. There is another boiler-house connected with the weaving department, which contains five boilers, of 520 nominal horse-power. The engines which supply power for the weaving department are of 450 horse-power. An additional engine of 100 horse-power supplies the finishing department, and another of the same capacity the machine shop. There are also numerous other engines, attached to various machines, in different departments of the worsted plant, which will aggregate 100 additional horse-power. If we add to these engines those of the cotton mills, we shall have an aggregate capacity of over 5,700 horse-power.

On Chalmers street, in the northwestern corner of the plot we have described, stands the storehouse, constructed in 1886. It is somewhat irregular in shape, owing to its peculiar location, but is nearly rectangular, and its dimensions are 125 by 135 feet. It is six stories high above the basement, and possesses an average actual area per floor of over 12,000 square feet, with a total floor area of 87,856 square feet, and a storage capacity of about 600,000 cubic feet. We present a picture of this fine building, and, by way of contrast, another picture of the first storehouse occupied by the Arling-

The storehouse.

THE FIRST STORE HOUSE—1867.

ton Mills. The two buildings are typical of the earlier and the later manufacturing of the United States. Vast as is the floor area of the new storehouse, it must be filled many times over to supply the wool which is annually devoured by the machinery of the mills.

Entering this building we find its basement floor crowded with goods, packed in cases, and ready for shipment, which occurs daily. The Arlington Mills is especially fortunate in its transportation facilities, its raw material being brought to its very doors, both to the worsted mills and the cotton mills, over its own tracks, which are extended through its yards, in various directions, from the Boston & Maine Railroad. At the cotton mills the arrangements are so perfect that the entire business of the mills is conducted without the aid of a single team of horses connected with that mill. The products of both mills are shipped daily, in cars provided by the railroad corporation, which are sent, without reshipment, all over the country.

The shipping facilities.

Entering the elevator of the storehouse, we pass story after story, in which the raw material is piled, bale upon bale, as it comes from the farms and ranches of Ohio, the far West, and still farther Australia. Here also are stored English wools, mohairs from Turkey and the Cape, the supply of wool kept on hand being necessarily large and varied, to meet the special requirements of the great variety of products for which the Arlington Mills are famous. It is not a particularly appetizing odor that salutes the nostrils on the upward journey through these mountains of wool, — not

Wool from all over the world.

at all suggestive of the beautiful snow-white fiber into which this dirty, clotted mass is transformed by the processes through which it subsequently passes. Into this storehouse, and out of it to the machines, there passes in one year a volume of raw wool aggregating nearly 10,000,000 pounds, — a quantity equal to one-thirtieth of the entire American clip for 1890. It is more than one-third of the clip of our greatest wool-growing State, and there are only nine States in the Union which raise an equal quantity of wool.

It will help the reader to realize the volume of wool represented by these figures, to state that two hundred mills, each using the same weight of wool which the Arlington annually consumes, would work up all the wool grown in the world. But the increased capacity of the larger mills in this country barely keeps pace with the increasing consumption of the American people. In 1870 the consumption of raw wool in this country was 7.94 pounds *per capita*, making allowance for the home production, and all the imported material, whether in its raw state or as manufactured goods. In 1880 the *per capita* consumption had increased to 8.55, and in the year 1890 it was 9.15 *per capita*. There is no country on the globe whose people approximate our own, in the quantity of wool they consume in clothing, carpets, and all its various forms. As the country grows, the United States may become the greatest of wool-manufacturing nations, without requiring a market outside her own borders.

Per capita consumption of wool.

Of the wools which the Arlington finds best suited for the fabrics there made, a very large proportion are imported. Im-

THE NEW STORE HOUSE—1886.

ported wools are used, not because of any prejudice or objection to American wools, but because they possess characteristics essential to the satisfactory finish of certain grades of the goods, to a degree not found in the domestic fleece. The woolen industry proper of the country is dependent almost wholly upon the domestic wools; and experience proves them as well adapted for the fabrication of satisfactory clothing for our people as any other wools grown.

The wool tariff.

The manufacturers of wool have, as a rule, cheerfully consented to the imposition of a high tariff upon the wools they import. Believing in the protective system themselves, and dependent upon it for their own success, they have not been disposed to deny its benefits to a kindred industry claiming to be equally dependent upon the tariff. They believe, also, the proposition that that nation is the strongest and most independent which not only makes all its own clothing, but grows all the raw material required for that clothing. The United States approaches more closely to this condition than any other country; it is the only one of the great manufacturing nations that grows more wool than it imports. Her manufacturers have been willing to thoroughly test the proposition made in behalf of the wool-growing industry, that, with proper protection, there can be raised in abundance in this country every variety of wool required in the manufacture of clothing. Twenty-five years of thorough-going protection have shown this broad proposition not to be well founded. It is human nature for the farmer to raise that variety of wool most certain of a steady market, at prices which

allow the best profit to himself. The necessities of the manufacturer are of no special concern to him, and as a rule he is not familiar with them. Under the operation of the tariff, the volume of the domestic clip has greatly increased; but the number of sheep has steadily declined in those parts of the country where climate, soil, food, and other conditions are best adapted to the raising of superfine wools. The special grades of wool required in special manufactures of worsted, are not grown here to-day to any greater extent than twenty-five years ago, and these wools must continue to be imported.

This digression occurs at a dangerous point, for we left the reader in an elevator. Returning to the storehouse, we mount to the top floors, where are located the sorting-rooms, in which the process of manufacture may be said to begin.

The sorting-rooms.

Here we find eighty to a hundred men, standing each in his stall, with great piles of wool before him, and from six to ten baskets at his side. Singularly enough, the sorting is one of the few steps in the whole complicated and protracted process of the worsted manufacture which must still and always be performed by hand. Such sport has modern invention made of language that "manufacture," which means to make by hand, has come to mean just the reverse, — to make by machinery.

The cleansing begins.

Everything throughout the mills is planned with a view to the greatest economy and the utmost expedition in the handling of the material as it passes from one manipulation to the next in order. From the wool-sorting room the fiber is carried, after further examination and

THE WOOL SORTING ROOM.

intermixing, to great pipes, through which it is dropped into the top story of another building, where it first undergoes a process, in a peculiar machine, for eliminating some of the dry dirt with which it is burdened in its marketed condition. The sight of the long rows of barrels of this dirt or manure that is extracted from the sorts before any water at all has touched them, suggests that the time ought not to be far distant when the manufacturer will be relieved of the necessity of buying dirt for wool, by its more careful preparation for market. As thus partially cleansed, the wool is again shot into the scouring department, below. This is a one-story building, with a length of 144 feet and an average width of 54 feet, which was erected in 1887, at the same time as the main spinning mill. Here the sorts are conducted to automatic steeping machines, which feed directly into the bowls of the scouring machines. From these the wool emerges, white, damp, and nearly clean, directly and automatically upon the dryers, and from the drying machines it is blown by fans to the card-room, without having been touched by hand since it left the feeder before the washing machines.

The scouring-room.

Following the buildings in the order of the rotation of the work, we come next to the north wing of the worsted spinning mill proper. It is 295 feet long and 100 feet wide, four stories high, besides basement, with a monitor roof, which affords the finest possible light for one of the spinning-rooms occupying the two upper stories. This wing has a floor area of 143,419 square feet.

The north wing.

The north wing runs nearly parallel with Chalmers street; while at right angles with it, and nearly parallel with Broadway, is the eastern wing, 144 feet long by 100 feet wide, erected in 1890. This new building is properly a continuation of the north wing; for its machinery is to be devoted to the continuation of some of the processes which begin in the latter. It contains a total floor area of 71,248 square feet.

The east wing.

It is impossible to describe the processes to which these buildings are devoted, and the machinery employed therein, in a manner that will be intelligible to one not familiar with the worsted yarn manufacture, without devoting to the subject more space than is at our command. Here is done the carding and preparing, the backwashing, the gilling, and the combing, the processes of manufacture necessary to the making of the worsted top; and the drawing, doubling, spinning, twisting, and roving necessary to the manufacture of the top into yarn. From the point when the wool enters the sorting-room until it leaves the spinning-room ready for weaving, there are no less than thirty different processes to be passed through, each one of which advances the manufacture one step.

The worsted process.

The carding-room of the Arlington Mills is on the second floor of the north wing. It contains fifty-eight sets of cards, mostly adapted to fine work. Into this room the sorts are blown by fans from the drying machines, to be at once fed upon the carding machines, if they are the short-stapled sorts to which the process of carding is best adapted. The monster cards absorb the tangled wool in their

The carding-room.

greedy jaws, draw it tenderly upon their various wheels, cylinders, and rollers armed with sharp teeth, shake from it any remaining dirt or foreign substance, and finally deliver it in the form of a dainty white film, which is automatically gathered into the card balls, ready for the preparatory processes which precede spinning. The best worsted carding-engines were formerly made in England, where many of those in the Arlington carding-rooms were secured. It is a pleasure to note the rapidity with which the American machinery manufacturers are meeting the most critical wants of the business in this department. The later purchases of cards are of American build, and are found to be superior to the English machines whose places they have taken.

The long-stapled wools are fed into the preparing machines, the object of which is to straighten the long fibers, in order that the operation of combing may be conducted with greater facility and with less damage to the staple.

Gilling.

The preparatory machinery, to which wool not carded is subjected, consists of what are technically termed "gill-boxes," constructed so as to draft and open the wools. The result of this operation is to form a "sliver," which is more or less uneven as it comes from the first gill-box. Five or six of these slivers are run into one by the use of a second gill-box, with the result of so intermingling them that the deficiencies in one sliver are supplied by its neighbor. In the meanwhile, the drafting operation continues, and the half-dozen slivers are finally drawn into one smaller than any of those of which it is composed. This operation continues through successive gill-

boxes, until the fibers, from the continued use of the "fallers" and "gills," have become thoroughly separated and parallel with each other, and ready for the combing machine, by which the straightening process is to be continued, and the knots and short fibers removed. The longest-stapled wools, prepared for combing without the use of the card, are sent to the Lister comber, commonly known as the "nip" machine.

The combing-room.

The short-stapled wools, which have been subjected to the carding process in the rooms above, are dropped through wooden pipes to the first story in the form of "card balls," where the material is first backwashed, in order to cleanse the wool more thoroughly and to dampen it so that it will work more freely on the combs. Several gillings intervene, and finally the material reaches the Noble, or circular comb, the use of which has greatly increased since the manufacturers began to utilize short-stapled wools for worsted spinning. The equipment of the Arlington Mills consists of fifty-three combing machines, most of which are of the Noble pattern.

A wonderful machine.

It has been said of the combing machine that it is one in which the power of the capitalist has been exemplified no less than the genius of the inventor. Experimental inventors spent no less than ten million dollars in perfecting the three distinct varieties of combing machines. The combing machine cost more to complete, and yielded more to its designers when completed, than any other machine of the century, and it is certainly the most perfect piece of mechanism to be found in

all the range of the textile industries. It is comparatively few years since the combing machine was brought to its present state of perfection. The first use of the machine in this country was in 1854, and our whole enormous industry of mechanical worsted spinning, as now conducted, has since been built up. It is only within a few years that the American manufacturers of textile machinery have undertaken the building of combing machines.

The recent introduction of mechanical worsted spinning is illustrated by the fact that there are to-day employed at the Arlington Mills men who were formerly engaged in combing by hand. They are fond of describing the slow and cumbersome process, and of recalling how confident the hand-combers used to be, long after the experiments of Lister, and Noble, and Heilmann were under way, that no machine could be invented that would successfully supersede hand-combing, and thus deprive them of their occupation. They were for a long time confirmed in this view by the imperfect product of the first machines in use, as compared with the hand-work.

The hand-combers.

Mr. John Carden, who has been for many years the wool buyer of the Arlington Mills, was a hand-comber in the great mills of Sir Titus Salt, at Bradford, prior to his emigration to this country, and he recalls that the Lister comber was at work in those mills in 1848. It was not until 1853, however, that its use became general. It was in the winter of that year that word was sent to the hand-combers that their services would no longer be

John Carden.

required, and the following spring Mr. Carden came to America. The hand-combers bitterly resented the final triumph of mechanical combing, little realizing how vastly its success would increase the number of operatives in the worsted industry.

Hand-combing described.

The hand-combers' tools were of the most primitive description, consisting of a pair of combs, one of which was alternately held in the hand, while the other was fixed to a post, and into it the raw wool, after having been properly washed, oiled, and heated in what was termed the comb-pot, was lashed. With the other comb, the workman then began the combing operation, the teeth of one comb being made to pass alternately through the tuft of wool upon the other, until the fibers became perfectly straight, smooth, free, and clear of the "noil," or short wool, which remained imbedded in the comb-heads. The sliver thus obtained was from four to twelve feet long, according to the wool from which it was combed. This sliver became the "top" for the spinner. Mr. Carden attributes the origin of the word "top" to the fact that the product of the hand-comber was wound by him into a roll which took on a shape quite like that of a boy's top, — large above, and tapering nearly to a point. But neither he nor any one else, so far as we know, has been able to explain in a manner equally satisfactory the origin of the word "noil." [1]

"Top" and "noils."

From this primitive process to the combing machine, is an advance as great as the ingenuity of man ever achieved at a single

[1] Charles Vickerman, in his lecture on "The Woolen Thread," says that the term is from the Latin, and means "knotty," or "not do;" but this is at least doubtful.

step. It is impossible to calculate how great has been the increase in productive capacity thus effected, while the effect in decreasing the cost of all worsted fabrics has been only less marked. Mr. Carden states that the hand-combers were paid by the pound of top combed, and that the rate of payment ran all the way from fourteen pence per pound of top, where Botany wool was used, to two shillings, and even more, per pound, where the fine Saxony wools were used. The cost of this preliminary process of manufacture thus bore a proportion to the cost of the raw material which seems almost incredible in these days.

Storage of "tops."

The "tops," which are the product of the combing machine, are taken from the cans to the balling machine, and wound into balls weighing four or five pounds each. These are sent to the storage-room, in the basement of the building, where they are stored in different departments, according to their quality, and left for a while to "season." Much of the yarn spun by the Arlington Mills is top or slubbing-dyed. That is, the sliver of the partially combed top is made into hanks called slubbing, and after being dyed by machinery is returned to the comb and recombed, thus straightening the fibers that have been ruffled in the process of dyeing.

Drawing, roving, and twisting building.

Adjoining the wool-washing building, and abutting one end of the new spinning mill, stands a brick mill four stories high, besides the basement, 108 feet by 66 feet in dimensions, which is devoted to the drawing, roving, and twisting of worsted yarns. One story is occupied wholly with machinery for drawing, two stories

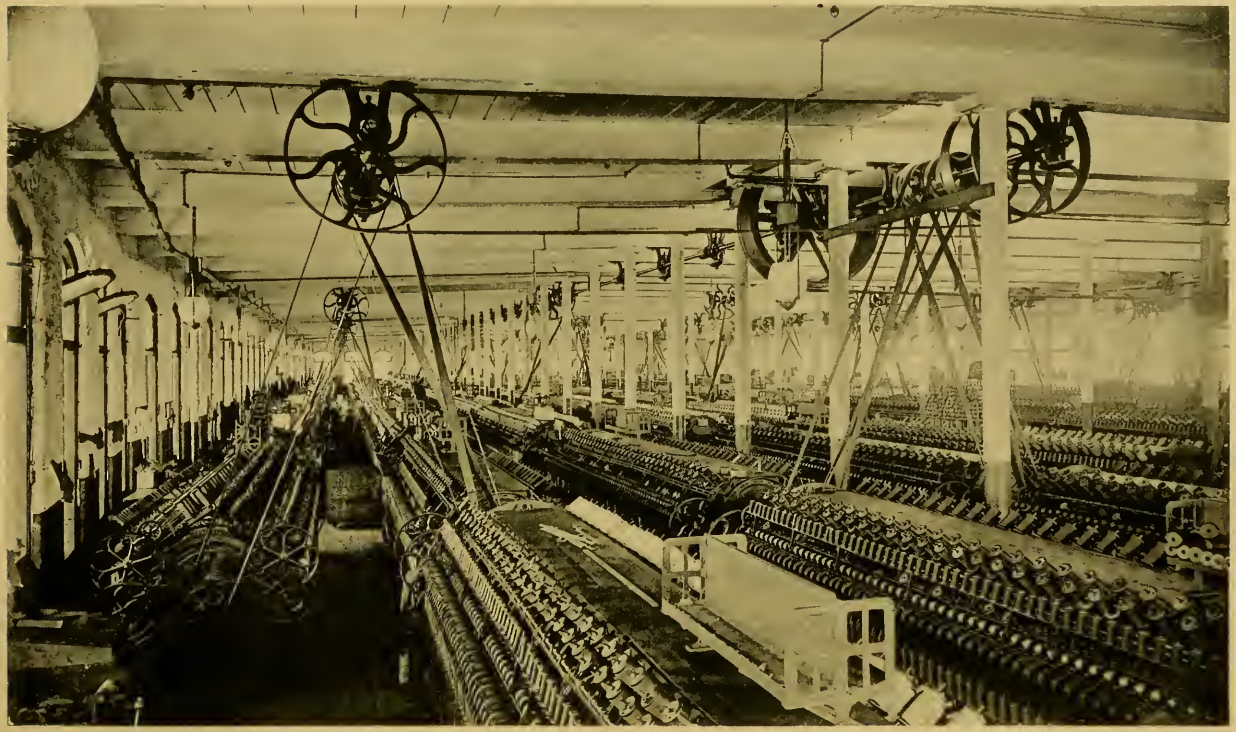
with machinery for roving, and one story with machinery for twisting. This building has a floor area of 33,403 square feet.

The drawing machines.

The object of drawing is to diminish the size of the sliver from, say, an inch or an inch and a half, down to an eighth of an inch, or so thin that it can be drawn out into a thread at one pull by the spinning machines. To effect this result, the slivers are doubled many times in order to eliminate irregularities from the yarn, and to insure uniformity of weight and texture. The ribbons are thus drawn out together to a length equal to the sum of their combined lengths. Some half-dozen machines are used in this process, all built on the same principle. Each machine has two pairs of rollers, one pair receiving and the other delivering the slivers, and traveling at different speeds; thus, if the deliverers revolve twice as fast as the receivers, the slivers are doubled in length in traveling from one to the other, the increase in the length, or the amount of the draft, being in the same ratio as the speeds of the respective rollers to each other.

The spinning-room.

From the drawing-room, the next advance is to the roving frame, the last operation through which the slubbing passes before spinning. Roving may be described as a combination of drawing and twisting, with an excess of drawing, while spinning is a combination of the same processes, with an excess of twisting. Finally, having passed the roving frame, the sliver is ready for spinning. We follow it back again to the spinning-rooms. They present a sight that must be inspiring to every spectator who has any



A SPINNING ROOM, WORSTED MILLS.

appreciation of the poetry of mechanism. It is impossible to secure a picture which will graphically portray a spinning-room to the eye; for the sense of infinite motion which fills the spectator is necessarily lost. The picture presented herewith will, however, convey some impression of the extent and general appearance of one of the worsted spinning-rooms of the Arlington Mills.

The worsted spinning is done chiefly by the cap and flyer systems. The new spinning mill will also be equipped with machinery for spinning by the French system, so called, which has been found to be better adapted, on some accounts, to the spinning of the shorter staples into the finer numbers of worsted yarns. In the manufacture of all-wool dress-goods, which the Arlington Mills has successfully undertaken in recent years, and to which it will devote additional attention upon the completion of its new mill, the counts of yarn used increase in fineness very rapidly. The fine French cashmeres, now so largely imported into this country, involve the use of yarns running between 60s and 80s, and in some cases even finer.

Mule spinning.

The enlarged facilities of the spinning department of the Arlington Mills include 41,916 spindles, of which 31,620 are flyer and cap spindles, 4,640 are mule spindles, and 5,676 are twisting spindles. As measured by the past achievements of the mills, this machinery is capable of turning out 2,660,000 pounds of yarn per annum, of an average number, 42. The average number of the yarns spun by the Arlington Mills has

Spindles and their product.

been gradually increasing in fineness, a fact which testifies to the increasing superiority not only of the goods woven by the mill itself, but by its customers also. In 1887 the output of the worsted department was 1,607,213 pounds, and the average number was about 38. The increased production of the mills, of a higher average count of yarn, is much greater in proportion than the increased machinery capacity, — a fact which proves that the standard productive capacity of spinning machinery is variable, dependent very largely upon the ability of the management to get the best results from a given capacity.

The method of calculating the sizes of yarn is so little known, outside the manufacture, that it may prove interesting to the lay reader to state it here.

How yarn is designated.

The conventional "hank" of worsted yarn measures 560 yards in length, and the conventional method of designating the size of a worsted thread is by the number of hanks that are required to weigh one pound; that is, —

1 hank, or 560 yards, No. 1 yarn, weighs one pound.
20 hanks, or 11,200 yards, No. 20 yarn, weigh one pound.
60 hanks, or 33,600 yards, No. 60 yarn, weigh one pound.

In two-ply yarns the count is designated by the number of hanks which are required to make a pound in the single; that is, 2-60 yarn means that 60 hanks of this yarn in the single would weigh one pound; in the two-ply, a shade less than 30 hanks, if the count is made exact in the single, owing to the take-up of the twist.

Woolen yarn is reckoned by runs or cuts, most commonly in this country by runs, 1,600 yards to a run; that is, —

No. 1 run means that 1,600 yards weigh one pound.
No. 2 run means that 3,200 yards weigh one pound.
No. 3 run means that 4,800 yards weigh one pound.

Cotton is also reckoned by the hank, only in this instance the hank measures 840 yards instead of 560; that is, 1-20's cotton yarn means that 20 hanks of 840 yards each weigh one pound.

This data will help the reader to follow us into a little calculation which is curious, even if it possesses no great value. The average length of each of the 2,660,000 pounds of worsted yarn which the Arlington spins is 23,520 yards, and its total length, when reduced to miles, is therefore 35,547,273. To realize the meaning of these figures we will suppose some energetic Puck to take the contract to lay this thread as a cable around the world, wrapping it round and round, a single strand at a time, and we will suppose him to secure the fastest means of locomotion which we now possess, and to travel continuously without stopping, at the rate of fifty miles an hour, day in and day out, year in and year out. This contract could not be terminated, making no allowance for accidents to our messenger, in less than eighty-one years. If we add the year's product of the cotton mills to this calculation, we will have a total length of yarn that would reach two-thirds of the distance from the earth to the sun.

A flight of the imagination.

With this little flight of fancy we will "return to our

muttons," or rather, we will return to our story of what happens to the fleece of the mutton in the Arlington Mills.

Twisting, reeling, and spooling.

At the westerly end of the boiler-house is located another building, formerly used for wool sorting and wool washing, but now devoted, in its three stories, to the twisting and reeling and spooling of worsted yarns, and their examination. This building is 108 feet long, 40 feet wide, and has a floor area of 12,648 square feet.

Dye-house, finishing, and packing.

Stretching from west to east along the northerly bank of the Spicket river are the dye-house buildings, and the finishing and packing buildings. These buildings are arranged so that by the use of fans the steam is very thoroughly removed, and light and air and good ventilation furnished. They are of an average width of 100 feet, and a total length of about 400 feet. They contain a floor area of 73,317 square feet.

We cannot pause to attempt any description of the operations of the dye-house. This is one of the most important stages of the manufacture, and one in which the Arlington Mills has been particularly successful. The corporation maintains a shade-room, where the secrets of exact matching are suggested by the black walls, which avoid reflected tints. There is also a complete laboratory, where results are produced by the experimental handling of dyes which are admired in the attire of the well-dressed ladies who walk the streets of American cities, and would have been the wonder and despair of the ancient alchemists.

Dyeing.

A bridge thrown across the river connects the last-described building with the brick weaving building, erected in 1879.

The weave-room.

This is one of the model weaving buildings in New England. It is but one story high above the basement, in order to avoid the vibration which occurs in buildings of several stories. It is 390 feet in length and 160 feet in width, having a floor area of 124,774 square feet, or more than two and two-thirds acres. It is light, airy, and roomy. The student of the textile manufacture can find in this building impressive exemplification of the perfection to which its processes have been brought. The main weave-room contains at present 950 looms of various patterns, for various kinds of work, — plain, Jacquard, box, broad, etc., — together with witch-engines and machines for special work.

In the basement are 550 additional looms, and with the completion of its new buildings the weaving capacity of the Arlington Mills has been increased to 1,802 looms.

Warping-rooms.

In the rear of the weave-room are warping-rooms. Here the warp threads, as they are prepared at the cotton mills, are set by hand and by machinery upon the warping beams in accordance with the pattern for which they are designed, and made ready for the looms.

As we enter the weave-room, a noise like that of Pandemonium let loose salutes our ears. The din and clatter of a thousand looms in operation at once is something indescribable. But as we grow used to the noise, we find everything proceeding with the most perfect precision, and are amazed at the variety of patterns that are being woven by

these machines with a rapidity so astonishing that to fully comprehend it, we must contrast it with the slow process of throwing the shuttle back and forth by hand, by which all fabrics were woven in the olden times. The loom, more than any other machine for textile manufacture except the comb, exhibits an automatic precision of several complicated motions most nearly approaching the human intelligence. It has been constantly improved, and to so marked an extent that the looms which the Arlington Mills have thrown out from time to time, because they had grown too antiquated for its methods, would equip another weave-room of nearly equal size. Among the looms which have thus been cast aside are many of English make; and it is a pleasure to be able to testify, in this connection, to the general superiority of American-built looms over those of any other country.

The power loom.

For many years after the invention of the power loom, it was deemed impossible to successfully weave the finer worsted fabrics, except by hand. As recently as 1870 the great majority of those engaged in this branch of the work at Rheims, the center of the manufacture of all-wool worsted dress-goods in France, were hand weavers. But the march of events has changed all this; for mechanical weaving long since reached a perfection such as the hand loom cannot attain. There is a greater regularity in the product, a smaller waste of material, and a great saving of labor, — one weaver in this class of fabrics easily attending to two looms, and thus attaining a product many times larger than was possible with the hand loom. The power loom is

Hand weaving.

THE ARLINGTON WEAVE ROOM.

worked without muscular effort, dexterity in the repairing of broken yarns being the chief requirement of the operative. Women are found to do this particular work with a deftness which men generally lack.

From some points of view, the finishing department is even more interesting than any of those which have preceded it in the manufacture. We now have the cloth all woven, but in a condition far from suitable for the market. If it is to be piece-dyed goods, that have come from the loom "in the gray," as it is called, the dyeing follows the weaving. If we glance back at the dye-rooms for a moment we shall see mammoth cauldrons, capable of receiving a hundred pieces of cloth at a time, and presenting an appearance almost as weird as that of any witch's cauldron of fairy tale. From this uncanny bath the cloth is taken to the finishing-rooms, where different machines and different processes await it, according to the character of the fabric and the nature of the finish it is desired to give it. Some of the technical names applied to these various processes are peculiar, and they had their origin, like many other terms familiar to the manufacturer, in the business itself, indicating the Anglo-Saxon origin of the processes they describe. The examination to discover the defects which may exist in a piece of cloth is called "perching," and the removal of the knots and kinks is "burling." Tentering, gigging, crabbing, and napping are among the processes that follow, some with some styles of goods, and some with all. Singeing is a manipulation which explains itself, although the

The finishing department.

Queer technical terms.

looker-on will wonder how it is possible to pass a fabric over a copper plate, heated to a white heat, so rapidly and so deftly as to burn from it only the excrescences, leaving the fabric itself unscorched and perfect. Washed, brushed, steamed, pressed in hydraulic presses, the goods are boxed and ready for the market. It has been a long journey; and the wool that traveled nine thousand miles from Australia, to begin this new trip through a worsted mill, has many times duplicated that original journey before it is ready for the wearer. To have followed it in this hurried way on its trip will serve perhaps to impress the reader with a new idea of the wonderful advance in civilization which the modern textile manufacture marks.

Singeing.

IV.

THE COTTON MILL AND ITS PRODUCTS.

THE business of the Arlington Mills grew so rapidly that the management was early brought face to face with the problem of undertaking the manufacture of the cotton warps and other cotton yarns required in its weaving department, rather than continue to buy and import them. Many of these yarns were then made in this country, of course, but as a rule the finer qualities had still to be obtained abroad. The field was one to tempt the growing enterprise of the Arlington, and in 1880 the construction of the cotton mill was begun. The summer of 1881 witnessed the completion of the first building, known as Mill No. 1, its equipment with machinery, and the beginning of production. It was from the start under the superintendency of Mr. Robert Redford, now the resident agent of the Arlington Mills, who brought from England the latest methods in use in that country, and whose skilful guidance made the enterprise a success from the very beginning.

The manufacture of cotton yarns.

This mill is situated in the town of Methuen, just across the Lawrence line. It is about one-quarter of a mile distant from the worsted mills, with which it is connected both by railroad and by a roadway on land belonging to the corporation. It is a handsome and substantial brick structure, three stories high above the basement, three hundred and sixty feet long and ninety feet wide, with a floor area of one hundred and thirty-five thousand six hundred and ten square feet, or more than three acres. This building is devoted entirely to the preparing, carding, and spinning of cotton yarns.

Cotton mill No. 1.

The cotton mill is pictured in this volume from two points of view, the rear view showing the whole group of the structures devoted to the cotton department, and the front view, of the main mill only, from which it will at once appear that its proportions are noble and symmetrical. In all its parts and details it is arranged with the same completeness which characterizes the worsted mills.

Cotton Mill No. 2 was constructed in 1885–6. It is located immediately contiguous to Mill No. 1, on the river Spicket, and is connected with the packing-room by a bridge. It is two stories in height, three hundred feet long by sixty-one feet wide, which gives a floor space of thirty-six thousand six hundred feet. Both these mills are equipped, like the worsted plant, with every facility for the perfect and expeditious dispatch of work. Mill No. 2 is fitted up with special machinery for twisting and warping, made both in this country and abroad, and also

Cotton mill No. 2.

THE ARLINGTON COTTON MILLS, FRONT VIEW.

with the most improved machinery for putting up yarns for the market.

The spinning capacity.

The cotton mills contain 62,000 spindles, of which 50,000 are spinning spindles and 12,000 twisting and doubling spindles. Of the spinning spindles, 17,000 are for mule spinning and 33,000 for ring spinning. The picture elsewhere presented of the main spinning-room in Mill No. 1 conveys a more graphic idea of its great dimensions and general appearance than any figures can do. This room is the special pride of the proprietors of the Arlington Mills, who have omitted from it nothing which science or money can provide for producing the best results, under the most economical conditions.

The other floors of Mill No. 1 are devoted to the various preliminary processes of the cotton manufacture. We shall not attempt even a cursory description of these processes, or of the machinery employed in them. The methods of manipulating cotton are very similar to those of wool manufacture.

Cotton and wool machinery.

The machines used, while they differ somewhat in construction, involve the same principles of mechanism. Many inventions, first applied to the manufacture of wool, are utilized in cotton, and *vice versa*. It is impossible to say which branch of the textile manufacture owes the most to the other in this respect.

The obligation is reciprocal, not only between wool and cotton, but between all the fibers, whether animal or vegetable. Whatever tends to simplify and cheapen the manufacture of one of them, is utilized in the manipulation of all;

and it is a remarkable fact that this consanguinity between the textile fibers, which is so strikingly illustrated in this interchange and combination, in modern manufacturing, has existed since civilization began, so far as the processes applied to their manufacture are concerned.

No new thing under the sun.

No book records when, or where, or how the discovery was first made that either animal or vegetable fiber could be drawn and twisted into a thread, which in turn could be woven into cloth. Wherever investigation has penetrated, there the spinning and the weaving are found to have existed. In Egypt, flax was the national fiber; in India, cotton; in China, silk; in Greece and Rome, wool; in South America, the hair of the llama. Each of the primitive civilizations possessed the art, and utilized it upon its indigenous fiber, and none of them can be said to have borrowed or inherited it from any other. More remarkable still is the fact that this art, as it thus existed throughout the world before the dawn of history, is in principle the identical art, as we practice it to-day. The sole point of difference is the substitution of power and machinery for the hand, and the marvelous inventions which have followed in the wake of that substitution. The carding machines of to-day are simply the hand cards of our ancestors, adjusted to power and automatic action, while the ingenious spinning machinery about which we have been writing is a direct evolution from the distaff and the spinning-wheel. These modern inventions which have so transformed the art of spinning and weaving are all founded upon the idea which the first sons and daughters of Adam understood as well as we. Widely as our textile indus-

tries of to-day differ from those of the ancients, they are still, in their fundamental processes, so like, as to justify the Old Testament dictum that there is no new thing under the sun.

A number of smaller buildings surround the two cotton mills, and serve their various subsidiary purposes. There are some twelve buildings in all, and they contain a total floor area of 232,772 square feet, or five and one-third acres. The general location of these buildings, with respect to each other, will be readily apprehended by consulting the plan of the mills already referred to.

Five acres of floor room.

At the northwesterly part of the plant, and situated in a bend of the Spicket river, is located the storehouse for cotton, 122 feet by 45 feet, three stories high, having a total area of 24,185 square feet, and storage capacity of 276,000 cubic feet, equal to five thousand bales of cotton. This quantity is about equivalent to one year's supply of cotton for the Arlington Mills. It is the rule of the management to procure its entire supply of domestic cotton at about the same time each year, and while the choicest selections are still in the market. The advantage of this course is obvious in a mill where special attention is devoted to the spinning of superfine yarns of a uniform quality.

The cotton storehouse.

East of the cotton storehouse stands the mixing-house, a building of two stories, 62 by 47 feet, with a total floor area of 4,470 square feet. The second story of the mixing building is on a level with the third story of the storehouse, and con-

nected with it by a bridge. Her the bales are opened, and the cotton undergoes the first manipulation preparatory to its manufacture. The cotton is dropped from this room to the mixing-room below, through holes in the floor. The latter room has a capacity of three hundred bales, and the cotton moves thence to the picker-house, a building east of the mixing-house, consisting of one story and basement, each 48 by 66 feet, and having a floor area of 8,284 square feet. Here the cotton encounters its first experience with machinery, in the preliminary process of cleaning, preparatory to the cards.

The mixing-room.

Attached to the southeasterly end of the main cotton mill is, first, a room 48 by 36, with an area of 4,479 square feet, containing a pair of Corliss engines of 500 horse-power, and an adjoining room in which is located a Green engine of 360 horse-power. The dimensions of the cylinders of these engines are 23 by 48. East of the engine-room is the packing-room, 52 by 45, and south of them both is the boiler-house, 102 by 42 feet, containing ten boilers, seven of which are five feet in diameter, and three of them six feet in diameter by sixteen feet in length.

Engine-room and boiler-house.

East of the picker-room we find a shed which is utilized as a continuation of the card-room. In this building are placed 125 English-built revolving top-flat cards, machines which possess a remarkable capacity for the rapid carding of cotton, and are also distinguished from the carding-engines they have superseded by their apparatus for the automatic cleansing of the card clothing.

It is an historical fact, worth noting here, that the Arlington Mills was the first establishment to introduce, to any extent at least, the revolving top-flat card in the cotton manufacture of the United States. Mr. Redford had seen them in operation in England, and noted their great superiority over the ordinary cotton-carding engine. Shortly after coming to this country to take the superintendency of the Arlington cotton mills, he introduced this machine, and his example has since been followed by many of the large cotton-spinning establishments on this side of the water. There are now several thousand of them in operation here.

The revolving top-flat card.

North of the main mill, and separated from it, is a small building, 31 feet by 23, used for the storage of combustible waste. All the waste accumulated by the Arlington Mills, both in the worsted and the cotton mills, is sold. No waste is utilized, even in the lowest grades of yarns which are here manufactured. This waste, the quantity of which is necessarily large, is utilized by others in the manufacture of carpet yarns, batting, etc.

Waste.

West of the southern end of the main cotton mill is another smaller building, 32 by 20, where oils are stored, and where is located also the needling-room, a very interesting spot to people of a mechanical turn of mind. The Arlington Mills makes all its own repairs, and not the least important branch of the establishment is that devoted to the repairing of combing-needles. It is estimated that no less than 10,000,000 needles a year are consumed in the repair of the comber cylinders and the top combs.

Ten million needles a year.

This statement does not help to answer the standing inquiry as to what becomes of all the needles; but it does reveal something of the infinitude of small details which goes to make up the routine conduct of a great manufacturing establishment.

North of the new twisting mill is a small building, 40 feet by 34 feet, in which the office is located. On entering it we shall probably find the superintendent, Mr. George W. Towne. Mr. Towne was trained in the Arlington cotton mill, and succeeded Mr. Redford as superintendent, in 1889. He will be glad to show us about the mills and explain the processes of manufacture.

Superintendent Towne.

Last year the cotton mills consumed 2,370,810 pounds of cotton, and spun 1,654,866 pounds of yarn. The average number of these yarns was 42.

The product of the cotton department, like that of the worsted mills, is of two kinds. All the warps that are required by the worsted mill in the manufacture of cotton-warp dress-goods are prepared at the cotton mill; but as the spinning capacity of the latter is much greater than the wants of the worsted mills, the company is in a position to supply the trade with cotton yarns in various forms.

Since its cotton department got fairly under way, the Arlington Mills has made a specialty of the manufacture of fine combed and carded yarns for the trade. In this respect it inaugurated a new branch of manufacture in this country. We believe its only predecessor in the manufacture of superfine sale yarns in this country was the Hadley Company, at Holyoke. Up to 1881, when this

A new manufacture started.

A SPINNING ROOM, COTTON MILLS.

feature was started, the great bulk of the manufacturers using fine cotton yarns were compelled to supply their wants by importation. This was a disadvantage in many different ways; there was always a considerable interval of delay between the sending of an order and the receipt of the yarns, and there was always a risk of not securing exactly what was needed. A great forward step in American manufacturing was taken when the Arlington Mills was equipped to supply, on short notice, cotton yarns of any character or quality that might be required.

That statement means much more than at first appears, as the reader will better appreciate when we add that there are some three hundred varieties of cotton yarns on the Arlington catalogue and trade lists, which are regularly made there. The necessities of their customers have called for all these forms of yarn, and the machinery has accordingly been provided. Some details of the varieties of yarn will prove interesting. The great number of these varieties is possible, because of the double variation which occurs, first in the count of the yarn, and, secondly, in its quality.

Three hundred varieties of yarn.

Six wholly different classes of yarns are made at the Arlington Cotton Mills. An enumeration of these classes will naturally begin with single-warp yarn. This is made in forty different sizes and qualities, from No. 10 to No. 80, inclusive. This range of varieties covers every requirement of the cloth manufacturer where single yarns alone are used.

Single-warp yarn.

If two-ply warps are wanted, there are no less than fifty forms or varieties from which to select. The range runs all the way from 2–20's to 2–140's, inclusive, which covers the field for a useful warp for any make of textile fabric.

Two-ply yarns.

Another branch of the business of this mill touches the cloth manufacturer closely, and that is the making of loom harness twine. The product of the loom, the character and quality of the cloth produced, depend in very large degree upon the quality of the harness employed. When the Arlington Mills began to make harness twine, in 1882, the manufacturers of loom harnesses were paying exorbitant prices for a poor quality of twine, one small mill practically controlling the twine business.

Harness twine.

It is related that this mill adopted a decidedly novel method of keeping the market firm when it was in danger of becoming overstocked. The plan was to stop the mill and take the help on a fishing excursion. If the harness-maker happened along, he must await the return of the party with what grace he could. The Arlington Mills undertook the manufacture of harness twine at the solicitation of both the harness-makers and the cloth-makers, and they have since continued it to the entire satisfaction of both interests, and not without advantage to the reputation of the mills; for the loom harnesses now made, at a reduction of thirty per cent. in the cost of the twine, involve an additional and more important saving to the weaver, for the harnesses last twice as long as they formerly did, doing better work all the time.

A fourth important branch of the products of the cotton mills is three and four ply thread, and also six cord. This is made in every size and quality used on sewing machines, and supplied to the thread spoolers, who put it up in all colors for home use or manufacturing purposes. The Arlington machinery has been especially selected with reference to this class of work, which requires a smooth, clean, even, strong yarn, every yard of which must pass through the eye of a needle.

Three and four ply thread.

Still another specialty of the cotton mills are the fine yarns used in the fabrication of plushes, both silk and cotton, and also in velvets. These yarns are supplied in every number and quality known to the business.

Plush and velvet warps.

Still another requirement, of comparatively recent origin, is yarn for electrical purposes, for winding the copper wire. The mills also manufacture seine twines adapted to the wants of those who require a strong, smooth twine for fishing nets and seines.

Electrical yarn.

In a word, these mills are equipped to make yarns of every description, put up in any form required by the textile manufacturer, either filling or warp yarn, colored or gray, on spools or on beams, ready for the shuttle or the loom. The range of the manufacture is shown by the fact that its products include the twine of which the harness is made, the yarns by which the loom is fed, and the thread by which its product is converted into clothing. In the manufacture of these various yarns the

The raw material used.

Arlington uses many varieties of cotton, — Allen seed, Peeler, Carolina, and Florida Sea Island, Egyptian, and Mississippi Egyptian, according to length of staple and other qualities required. The Peeler cotton is utilized in carded yarns, while the Sea Island, with a staple varying from one and three-fourths to two inches in length, is combed and spun into yarn of superior grades.

Some idea of the number of processes necessary to make one of these yarns, and the number of doublings required to make it even, can be very easily conveyed to the reader. A two-hundred-yard spool of No. 50 six-cord thread has been doubled and drawn upwards of 32,000,000 times between the picker lap and the finished thread. It will help the reader to understand how this can be possible, when we add that a single pound of Egyptian cotton has been spun to a length of 238 miles and 1,120 yards.

Thirty-two million times.

It has been stated that the consumption of cotton per spindle in the American mills in the year 1825 averaged about one hundred and forty pounds per annum. The change that has since occurred in the manufacture may be illustrated by the fact that the average annual consumption per spindle in the Arlington Mills was about forty-eight pounds in 1889. That means that the mill is spinning yarn three times as fine as the average yarn spun in the country in 1825. If account be taken of the greater rapidity with which the modern spindle revolves, it easily means four times finer.

We are now spinning cotton yarns in the United States of as fine numbers as are produced at Manchester, England, and in time we shall supply all the quantity of the finer numbers that we consume. Naturally, the machinery employed upon the finer numbers is mostly located in the New England States, and will continue indefinitely to be thus located. By the census of 1880, the average number of the cotton yarn spun in the whole country was 28.56, while in the New England States the average number was 30. In the Middle States the average number was 25.4; in the Western States it was 13.6; and in the Southern States it was 13. These statistics supply all the answer necessary to the opinion — quite freely expressed in recent years — that the cotton manufacturing industry is drifting from New England into the Southern States. The spinning capacity of the South has largely increased, and will, no doubt, continue to increase; but it is not an increase which takes place at the expense of New England. The coarser cottons used by the Southern people will more and more be spun and woven on her own territory, and in immediate contiguity to the cotton plantations. But it will be many years yet before the South will seriously attempt competition with the New England mills in the spinning of the finer numbers and the weaving of the finer fabrics, such as lawns and dress-goods. The increased consumption of our people — whose numbers grow at the rate of a million and a quarter a year — will keep the mills of both sections busy, without inaugurating anything like direct competition between them. New

New England and the South.

New England spins fine yarns.

England manufacturers have, in fact, more to fear from their own number, so rapidly have they been increasing their facilities of recent years. It is believed that the 10,000,000 spindles which existed in 1880, by the census of that year, have increased to 15,000,000 in 1890; and of this increase, notwithstanding the great growth in the South, New England has undoubtedly secured the share necessary to retain her former preëminence as a cotton manufacturing center.

We find an interesting confirmation of the views here expressed, in a letter written just forty years ago, by Hon. Amos Lawrence, to Robert Barnwell Rhett, of South Carolina. Mr. Lawrence anticipated the time when South Carolina would spin her own cotton. He looked to see that time come within ten years, — he was writing in 1849; and if he was over-sanguine, it was because he could not anticipate the terrible ordeal through which the South was to pass, before it could attain to industrial conditions under which it would be possible to duplicate, in that section of the country, the manufacturing enterprises of New England. With a full understanding of the manufacturing situation in his own State, Mr. Lawrence wrote: "We of Massachusetts will gladly surrender to you the manufacture of coarse cotton fabrics, and turn our industry to making fine articles. In short, we could now, if you are ready, give up to you the manufacture of coarse fabrics, and turn one-half our machinery into spinning and weaving cotton hose; and nothing will help us so much as specific duties. The whole kingdom of Saxony is employed at this moment in making cotton hose for the United States, from yarns purchased in

England, and made of your cotton. How much better would it be for you and for us to save these treble profits and transport by making up the cotton at home! Think of these matters, and look at them without the prejudice that prevails so extensively in your State." The United States did not act upon Mr. Lawrence's judgment, with respect to specific duties upon cotton hosiery, until 1890, and in consequence a large proportion of the cotton hose worn by the American people has continued to be imported down to this time.

Our growth of fifty per cent. in a single decade, in the other branches of the cotton manufacture, finds no parallel in any similar period of the history of Great Britain. Indeed, the official returns of that country show that there was but slight gain in the number of her spindles for a period much longer. In 1874 the spinning spindles reported in England, Ireland, and Scotland numbered 37,515,000, and in 1889 this number had only grown to 40,511,000. An increase of fifty per cent. in our spindles, in ten years, is, therefore, to be contrasted with an increase of but nine per cent. in Great Britain in fifteen years. It is necessary, however, to take account of the fact that the capacity of spinning machinery has greatly increased during the interval, so that the figures are not altogether a fair test of the rate of increase, either in Great Britain or in this country. They serve to prove what we know in other ways, that the percentage of the world's cotton crop manufactured in this country increases regularly, and at a rate most gratifying to those who believe

The increase in spindles.

The spinning capacity of Great Britain.

that we are as capable of manufacturing all the cotton we consume, as we are of growing it.[1]

Atmospheric conditions.

The experience of the mills which have engaged in the spinning of the finer cotton yarns has satisfactorily disposed of the claim that there are atmospheric and climatic conditions, peculiar to this country, which prevent our attaining results equal to those reached in England. Undoubtedly, the conditions are frequently more trying; they embrace extremes of heat and of cold from which others are exempt. But so far as these or other conditions, such as excessive electricity in the air, perceptibly affect the manufacture, it has been found a simple matter to overcome them by spraying apparatus, which will exactly secure any degree of atmospheric humidity which may be desired.

[1] The United States now consumes in its cotton manufactures between 30 and 33⅓ per cent. of its annual production of the fiber, and the proportion is slowly but steadily increasing. Prior to 1840 more than three-fourths of our production was consumed in foreign mills, but our manufacturing interests have increased by a little more rapid ratio than our production. The following table presents, in condensed form, the average production and exportation, by decades, from 1841 to 1880: —

Period.	Production.	Exportation.	Per cent. exported.
	Pounds.	*Pounds.*	
1841–50	1,013,706,315	739,182,698	72.9
1851–60	1,656,207,661	1,118,106,790	67.5
1865–70	1,297,745,903	860,437,420	66.3
1871–80	2,183,174,113	1,493,829,284	68.4
1881–88	3,084,627,890	2,082,339,412	67.5

In the equipment of her cotton mills and in the quality of their products, New England may now fairly claim an equality with Old England. If she cannot manufacture so cheaply, it is because she uniformly pays higher wages to all classes of operatives in her mills. While that remains a fact, New England will not crowd Old England out of the foreign markets she has so laboriously cultivated for a century, but she will find an ever-increasing field for her capital and enterprise in supplying a home market which no other nation can equal, and which ought to be sacredly guarded in the interests of all classes of our people and all parts of our country.

New England and Old England.

V.

THE WORSTED MANUFACTURE IN THE UNITED STATES.

BEFORE entering upon a description of the worsted products of the Arlington Mills, it will be interesting to glance briefly at the history of this particular branch of textile manufacture, which, although among the most recent, has already grown to extraordinary dimensions abroad, and is rapidly advancing to the front rank, among the products of wool, in the United States.

Historical.

Throughout this book we have used the expression "wool manufacture" as indicative of all methods of fabricating woolen fabrics, although we have been dealing solely with the processes commonly known as the worsted manufacture. Notwithstanding the fact that a United States Court and a jury of twelve American citizens solemnly decided, in a trial which took place in New York in the spring of 1890, that a worsted cloth is not a woolen cloth, it nevertheless remains the fact that a worsted cloth is made of

Woolens and worsteds.

wool, that many of the processes are identical with those employed in making all other cloths, and that the variations which occur in the manufacture of cloths commercially known as woolens are as marked, particularly in the final process, as the variations which occur between woolens proper and worsteds proper. For instance, there is a species of cloth popularly known as Jersey cloth, which is not woven upon the loom at all, but knitted upon knitting machines, very much as shirts and drawers are knitted. But it is a woolen cloth for all that: it belongs to the great family of cloths, being one species of the genus, just as worsteds are another species, and just as there are different groups of worsteds for men's wear, and also of dress-goods for women's wear, between which there are almost as many points of difference as there are between woolens and worsteds. For instance, there are worsteds made of long stapled wool which is prepared and combed, worsteds made of short wool which is carded and combed, and worsteds made of wool of any length, which is carded only. It is often impossible to tell by which one of these three methods a particular worsted yarn has been made; and yet one of the methods in its preliminary process is identical with that of woolen yarn manufacture. Nature divides her grand groups into different species, which differ greatly in their characteristics, but have certain points of organic resemblance; and in much the same manner the manufacture of cloth is divided into its different groups, which have one common, invariable, and organic resemblance to each other, in that the chief material out of

The cloth family.

which they are all fabricated is wool from the back of the sheep.

Bearing this general resemblance in mind, it is not difficult to point out the distinction between woolen fabrics, so called, and worsted fabrics, so called. It comes from the different treatment to which the wool is subjected in the process of manufacture. Of the two processes, that of worsted manufacture is much the more complicated and expensive, particularly in the earlier stages, which have to do with the spinning of the yarn for the loom. The woolen yarn is carded and spun on a mule, with few intermediate manipulations. We have seen in our trip through the Arlington Mills that these intermediate processes are very numerous and delicate, in the spinning of the worsted yarn. Their introduction produces a yarn quite different, in its general appearance and characteristics, from the woolen yarn. While this difference is perfectly apparent to the eye, it will most readily be understood by subjecting them both to microscopic examination. Placing a woolen yarn under a glass, we shall find it composed of a mass of tangled fibers, interlocked and interlacing with little or no system, loosely associated together and lacking in tensile strength. A worsted yarn will be found, upon a like examination, to be composed of fibers of wool which run parallel with each other, and are closely twisted into a strand which is comparatively smooth and comparatively strong. This difference between the two yarns is primarily created by the use of the comb and the gill-box, machines unknown to the woolen manufacture proper. The comb, as we have previously

How woolens and worsteds differ.

seen, is so constructed as to lay the long fibers of wool parallel with each other, eliminating the short fibers, called the noils, which are all retained in the woolen yarn. The short fibers must be gotten rid of, in worsted spinning, prior to the subsequent processes of drawing, whereby the long fibers are gradually drawn into a thread which possesses a uniform thickness and a uniform strength.

The difference between a woolen and a worsted yarn is not confined to the operation of the comb alone. The whole process of making a woolen thread is fundamentally different from that which we have seen applied in worsted. As Vickerman has described it, worsted spinning is a series of processes continuously following each other, while woolen spinning is a compound process intermittently carried on. There is no drafting in woolen. The woolen sliver, after leaving the last carding engine, — called the condenser in England and the finisher here, — is wound at once upon bobbins attached to the mule. In this machine the spindles have a compound motion of revolving and receding simultaneously in progress, whereby the sliver is drawn and wound. This operation completes the woolen thread. It is a soft, fluffy, fringy yarn, in which the longer fibers have gravitated to the core, and the shorter fibers constitute a covering. Such a yarn requires very different treatment from the worsted yarn, both in the weave and the finish. Instead of the compact weave that distinguishes a worsted fabric, the woolen fabric, as it comes from the loom, is loose, open, rough, and must be thoroughly fulled to become a wear-

Woolen yarn.

able cloth. The felting constitutes the final difference between the woolen and the worsted cloth. While the felting property is not eliminated from a worsted, it is so minimized that in a worsted fabric, such as a diagonal or corkscrew, we have the characteristics of the weave distinctly visible.

The method of making yarn known as woolen, as distinguished from worsted, was exclusively employed in the mills of this country for more than half a century after the founding of our textile manufactures. By this process were made a great variety of fabrics commonly worn by the people, and including broadcloths, doeskins, twills, flannels, tricots, beavers, and like goods. The wonder is, however, that our manufactures of wool were so long confined to the woolen form; for early in the century the worsteds became popular in Europe, and before any were made in this country the worsted manufacture had nearly equalled that of woolens, both in England and France.

Our early mills.

In the production of the almost infinite variety of fabrics included in the general description of worsted dress-goods for women's wear, France undoubtedly stands at the head of the manufacturing nations — not, perhaps, in the quantity of these goods manufactured, but certainly in quality and in variety. Although we know of the existence of the worsted manufacture in England as far back as the records of her industry extend, and although the very name of the product is thought to be derived from the name of a town in Norfolk, where a colony of spinners from

The French worsted manufacture.

Flanders settled in the time of William the Conqueror, yet the French may be called the originators of the modern worsted manufacture as applied to the lighter fabrics adapted for female apparel. They not only originated the most beautiful and popular forms of these fabrics, but they continue to carry on their manufacture with the most conspicuous success, attaining a fineness and perfection of texture, and a beauty and novelty of design, which are the wonder and the envy of other countries. The wonderful fecundity of the French intellect in the invention of graceful combinations of design and color finds in this industry an unlimited field.

Rheims.

The fabrics of combed wool for which Rheims was so famous for centuries, — the says, serges, and tanimins, — disappeared with the introduction of the Spanish blood into the French sheepfolds. As early as 1811 an obscure workman of Rheims, Dauphinot Palloteau, first made from the soft and long wool of the Rambouillet sheep the most unrivalled of modern woolen fabrics, — the French merino; and at an even earlier date the ingenious manufacturers at Roubaix had made a world-wide reputation for the excellence of their stuffs. The great development of this branch of industry dates from the time when the utilization of the short-fibered wools of the merino blood was successfully inaugurated. Until the early part of this century, the long-stapled wools, like those of the English mutton sheep, were regarded as the only combing wools; and yarns made of such wools had never been used in cloths for men's wear, but were utilized only in stuffs,

Roubaix.

or thin, unfelted fabrics, such as dress-goods and coat linings. A number of minor improvements in machinery contributed to the change, but the revolution was completed and perfected when Josue Heilmann, an Alsacian inventor and manufacturer, succeeded, after many trials and failures, after alternating hope and despair, in working out a method of mechanical combing adapted to the short fibers of merino wool, as well as to the long staple formerly regarded as exclusively combing wool. M. Alcan, the leading French authority, while he lived, on the textile industries of that country, spoke of this invention as one by which "the means of fabrication were so ameliorated, in the short space of a quarter of a century, that the spinning of merino wools attained a fineness and regularity once impossible with the best hand-spinning. The machine turned out lengths of yarn 200,000 meters to the kilogramme, from a kind of wool which twenty-five years earlier would scarcely have produced 50,000 meters." From the time of this invention the distinction between woolens and worsteds gradually ceased to be due in any necessary degree to a difference in the character of the wool employed, for thereafter it became possible to comb almost any wool, however short the staple; and in like manner the long wools of English origin, called the combing wools, are now used indiscriminately in the manufacture of carded fabrics.

M. Alcan quoted.

To the French is due the credit of the first manufacture of all-wool mousselines de laine, and also of the cotton-warp. The first fabrication of the latter occurred at Rou-

baix, about 1831, and it was quickly copied at Bradford, in England, where more of these goods have since been made every year than anywhere else in the world. Mr. E. R. Mudge, United States Commissioner at the Paris Exposition of 1867, was greatly impressed with the evidences he found there of the textile ingenuity of the Roubaix manufacturers. "For half a century," he said, in his admirable report on the manufactures of wool at that exposition, "the industrial life at Roubaix has been one series of enterprises and happy experiments. Its dominant idea has been to adapt fabrics of luxury to popular consumption, by combining the best taste and highest excellence with the lowest possible price. With this idea it has constantly varied its materials and styles, combining wool with cotton, with silk, with mohair, with flax, but in all the economies of production preserving a grace of decoration and sobriety and harmony of colors which take from cheapness all its vulgarity."

Cotton warps.

E. R. Mudge quoted.

Mr. Mudge's observations at the Paris Exposition suggested to him, on his return to this country, the use of the short-stapled merino wools of domestic growth, in the manufacture of worsted suitings for men's wear.[1] He entered upon this new enterprise with characteristic energy and skill, at the Washington Mills, of which he was then the selling agent. His

Worsted suitings first made.

[1] John L. Hayes gives the following account of the origin of Mr. Mudge's enterprise: "In 1868, my friend, Mr. R. M. Montgomery, then president of the Ohio Wool-Growers' Association, sent to me, at Boston, an entire fleece of unusually long Ohio merino wool,

success was so marked that others quickly followed him into this new and promising field, and to-day many of our largest and best mills are engaged in the fabrication of a great variety of worsted cloths, which, in originality of design, in durability, in fineness of texture, and in price, compare favorably with the products of the most famous foreign looms.

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that I might bring it to the attention of practical manufacturers. I kept the fleece in my office many months. I repeatedly showed it to manufacturers, but they seemed to take but the slightest interest in it. One day, when the fleece had become so full of moths that I was upon the point of throwing it away, Mr. E. R. Mudge, who had been a commissioner at the Paris Exposition of 1867, and had been much impressed with the worsted cloths, which, for the first time, had been exhibited there, and were utterly unknown in this country at that time, came to my office to inquire if any wool suitable for making such cloth was grown in this country. Upon his description of the cloths, I at once said that they were made of merino combing wool, and pointed out to him Mr. Montgomery's fleece, assuring him that there was an unlimited supply of such wools in this country. The next day an expert was sent by Mr. Mudge to examine the fleece; and, upon his report, orders were sent to France for combing machinery by the Washington Mills, of which Mr. Mudge was a director and the selling agent. In the course of a few months the first merino worsted coatings made in the United States were turned out by the Washington Mills, and were sold in the market as French goods. This establishment succeeded so well in the fabrication of their cloths, generally called worsted coatings, and they proved so popular when thrown upon the market, that the introducer soon found a host of rivals and imitators."

On the other hand, similar fabrics were made at about the same time by the Hockanum Company, of Rockville, Conn. Mr. George Sykes, the vice-president and superintendent of that company, writes that about 1869 or 1870, he was shown samples of a new fabric for men's wear, then being made in England, which, upon examination, he found to be made of about the same quality of wool they were then using in their woolen goods, but that the fibers were combed and laid parallel, thus causing the figure in the weave to show up much brighter and clearer than it could be made to do with a carded thread. He learned upon inquiry that yarns of this nature had been used in and around Huddlesfield in making vestings, and that Mr. Josiah Lodge, of Huddlesfield, claimed to have been the first to utilize them in trouserings and coatings. Mr. Lodge was then the designer for Taylor & Sons, and is now one of the leading manufacturers of fine worsteds at Huddles-

THE ARLINGTON WORSTED MILLS, REAR VIEW.

Recurring again to that feature of the worsted manufacture which has done most to develop the industry and to benefit the people, the introduction of the cotton-warp, we may safely agree with the late Dr. John L. Hayes, for twenty-three years the secretary of the National Association of Wool Manufacturers, in his statement, made

John L. Hayes quoted.

field. Mr. Sykes at once looked about him to find some one in this country who manufactured this style of yarns, and came in contact with Fiss, Barnes, & Erben, of Philadelphia (now Erben, Search, & Co.), who were spinning worsted yarns, but had never made any for men's wear goods. They were reluctant to undertake it, as new machinery would be required. But this they agreed to put in, upon Mr. Sykes' assurance that more of the yarn would be called for. His first order was for 300 pounds of yarn, which he put into sample pieces of worsted, which the company sold in the fall of 1870. This 300 pounds of yarn lasted for some time, but to-day the company is using more than 12,000 pounds of the yarn every week. Up to the time mentioned, Mr. Sykes adds, the Hockanum Company had never heard of the manufacture of this description of goods in this country, and their agents assured them that their product was the first to appear in the American market.

Mr. Henry G. Kittredge, the editor of the "Boston Journal of Commerce," who has devoted much time to the historical phase of our wool manufactures, recently published an article which tends to show that the Hockanum and the Washington Mills placed their worsted suitings for men's wear upon the market at about the same time, namely, the fall of 1870 or the spring of 1871. Mr. Kittredge writes: "In the treasurer's annual report to the Washington Mills' stockholders, Dec. 24, 1868, we learn that in 1864 two combing machines with necessary preparing and spinning machinery were purchased for making worsted yarns. With this machinery the mills experimented on various fabrics with more or less success until 1868, when, in the words of the report, 'an article of very general utility was perfected,' for which new worsted machinery was bought, also looms of new and improved construction, for the manufacture of goods which had been before wholly imported, thus diversifying the product of the mills and 'adding one more and a very important branch to American industry.' Though this report has been differently interpreted by authorities, it has great significance, in our minds, to the matter before us. It appears, upon the statement of the overseer of the finishing department at that time, that regular shipments of these goods were made in 1868, which would go to show that immediate steps were taken toward their manufacture after Mr. Mudge's return from the Paris Exposition. Whatever doubt may surround this statement, we have indisputable evidence that

in 1876, that "No event of the century has done more for female comfort, and for the industry of wool, than the introduction of the cotton-warp, and its extensive utilization by means of improved machinery. Cotton, instead of the rival of wool, became at once its most important auxiliary, and has added vastly to its consumption; for this utilization of cotton permitted a much cheaper fabric, practically the same as a woolen fabric, and one so covered with wool that the presence of cotton can only be discovered by the closest inspection."

It will be interesting to recall and preserve the successive steps by which this new industry was established and firmly rooted in the United States. We confine our sketch solely to the development of the dress-goods branch, which preceded by more than twenty years the introduction of the manufacture of worsted suitings. It is believed that there are but two men now living who were intimately connected with the earliest enterprises in this direction.

The first dress-goods made here.

about the middle of 1869 light-weight worsteds were being manufactured in quantity, made from Canadian and Kentucky wools — 2-60 yarn for warp and filling. In course of time American fleece was largely used. It was not till the latter part of 1870, or the early part of 1871, that heavy weights were begun to be manufactured, at the suggestion of Joseph Sawyer, a partner of Mr. Mudge, in the commission business. The first effort in this direction was in imitation of a diagonal worsted cloth which Mr. Sawyer had had made into a frock-coat by a London tailor, in July, 1870. The weave of this diagonal has been fortunately discovered of late as the product of the pattern loom. It is an eight-harness pattern with a backing. The first heavy goods marketed, however, were with a twill face and basket back — a double cloth — made from the fifth sort of Canada wool. P. C. Kirk now of the firm of Kirk, Hutchins, & Stoddard, worsted cloth manufacturers, of Auburn, Mass., was, during this period, the efficient superintendent of the mills and the executive man in carrying out the orders of his official superiors. The success of these ventures was largely due to his skill and surveillance."

These are Mr. W. C. Chapin, of the Riverside Mills in Providence, for eighteen years the resident agent of the Pacific Mills at Lawrence, and Mr. Samuel R. Payson, of Boston, the president of the Manchester Mills. Both of these gentlemen recall vividly and entertainingly the struggles, the difficulties, and the triumphs of the new departure with which they had so much to do.

The first delaines made in the United States were manufactured at a mill in Ballardvale, Mass., of which Mr. J. P. Bradlee was afterwards the general agent and chief owner,— a mill which holds an honorable position in the textile annals of the country as having been the first to manufacture fine flannels. The manufacture of delaines was undertaken at this mill by John Marland, who seems to have rented power and machinery for that purpose, employing about fifty looms. Associated with Mr. Marland in this enterprise was Jeremiah S. Young, his brother-in-law, formerly a clergyman at Portland, Maine, and subsequently treasurer of the Pacific Mills. All the wool was combed by hand, and the experiment extended to delaines for printing, and to others for dyeing in the piece. For a time they were printed by the block process at North Andover, and afterwards on the machines of the Hamilton Manufacturing Company at Lowell. Mr. Chapin also printed some of these goods at his printing mill at Fall River. Mr. Marland was not a manufacturer of large means, and although he had great perseverance, his enterprise cannot be said to have been successful. One difficulty encountered is said to have been the unwillingness of the American market to accept these home-made goods, — a diffi-

John Marland.

culty which was partially overcome by imitating foreign marks, and disguising in every way possible the domestic origin of the goods. This obstacle is one which our woolen manufacturers encounter more or less to this day. The American people have imposed more obstacles in the way of the success of home manufactures, by their prejudice in favor of foreign goods than it is easy to estimate, or to speak of with patience. It is a prejudice which undoubtedly had justification in the superior texture and design of foreign goods at the time when the industry was young among us. But it yields too slowly before the steady advances which have been effected in all branches of the wool manufacture.

Prejudice against American-made goods.

The second establishment to enter upon this line of manufacturing was the Amoskeag Company at Manchester, New Hampshire. This company owned a small mill at Hookset in that State, which it refitted for the purpose of making delaines, equipping it with two hundred looms. The goods were printed at Greenwich, Rhode Island. The manufacture was continued at Hookset for about seven years.

The Amoskeag Company.

In the meanwhile, several of the Amoskeag stockholders organized, in 1845, a new company, the Manchester Mills, situated in the town of that name in New Hampshire, and at once built an extensive factory for the manufacture of delaines. At first, this company used carded wool only — combing machines were introduced about 1855, very shortly after they had superseded the hand comber in England and France. The wool

The Manchester Mills.

was carded on what was called a tantrem card, and spun on a mule by a process similar to that of cotton spinning. The wools used were a high grade of Ohio and Pennsylvania merino. The Manchester Mills printed their own goods from the start. All delaines had previously been printed by hand, with what was known as the block machine, — a slow and expensive process. At Manchester the so-called Birch machine was used for a time; but Mr. Payson, whose connection with the Manchester Mills dates back to 1847, informs the writer that the use of the cylinder for printing calicoes, at Manchester, almost immediately suggested the similar method of printing delaines now universally adopted. It is believed that the first use of the printing cylinder for this purpose was at Manchester.

Delaines.

The original delaines made by this company were goods averaging about seven yards to the pound. The fashion which made them popular changed about 1868, but printed goods are still made at these mills, weighing about eleven yards to the pound, and chiefly for summer wear. The early popularity of the fabric may be inferred from the fact that the Manchester Mills made delaines of the value of $1,000,000 per annum. The corporation has been continually improving its machinery and enlarging and varying its product, and retains a front rank among the largely increased number of establishments devoted to this industry.

Hamilton Woolen Company.

The success of these pioneers brought others into the field. Shortly after the Manchester Mills were started, the Hamilton Woolen Company, at Southbridge, Massachusetts, converted their mill from a woolen-cloth

factory into a dress-goods mill; and in 1853 the Pacific Mills, at Lawrence, was organized to make the same class of fabrics.

Mr. Chapin was associated with the Pacific Mills from their origin, first as the superintendent of the print works, but soon after as resident agent,—a post which he retained until about 1871. He states that they began making their delaines out of woolen yarn; but almost immediately they imported the first combing machines ever brought to this country, and at once began their use. There were six of these machines, of the Lister pattern, in operation in 1854.

William C. Chapin.

As time passed, the various forms of the worsted manufacture, as developed on the Continent, began to find exponents in this country. The Washington Mills was the first to embark in the manufacture of certain all-wool fabrics, formerly made only in France. This branch of the industry has met with greater difficulties in this country than any other, for reasons which are well understood by practical manufacturers, and not least among which is the comparatively high labor cost of producing goods, on account of the fineness of the yarns used. However, several of our manufacturers have reached a remarkable degree of excellence in these fabrics, the Arlington Mills being conspicuous among them.

The Washington Mills.

The Arlington Mills was the first to introduce, in the United States, the successful manufacture of black alpacas, mohairs, and brilliantines. At about the same time, similar

goods, of most excellent quality, were made by the Farr Alpaca Company, at Holyoke, Massachusetts. Up to 1872 it was the common belief that these goods could only be made at Bradford, England, where their manufacture was first undertaken, and where peculiar advantages existed for its successful prosecution. In that year the Arlington Mills began to turn out goods whose immediate popularity in the market proved them to be equal, at least, to the productions of the best manufacturers in the old-established seats of the worsted manufacture in Europe. The achievement was the result of a large expenditure of money, judiciously applied from the beginning to the manufacture of goods which could hold their own in comparison with imported fabrics of like character. At the Philadelphia Exhibition of 1876 the Arlington Mills made an exhibit of these goods, with one exception the only exhibit of the kind from an American mill. The goods attracted marked attention, and especially excited the wonder and admiration of foreign visitors, who saw in them the evidence that the United States would rapidly become a competitor with France and England in the fabrication of higher lines of goods than had hitherto been made in this country. The judges made an award to the Arlington Mills "for a very superior collection of black alpacas, brilliantines, figured mohairs, and Roubaix poplins; all first-class goods of their kind, very uniform in width, color, and finish, and being of recent introduction reflect great credit on the manufacturers." We give a copy of the diploma on the following page: —

Alpaca and mohair.

The Arlington Mills at Philadelphia Exhibition.

INTERNATIONAL EXHIBITION.

1876

CERTIFICATE OF AWARD.

ARLINGTON MILLS, LAWRENCE, MASS.

ALPACAS AND BRILLIANTINES.

No. 370 . . . Group 9.

UNITED STATES CENTENNIAL COMMISSION.

In accordance with the Act of Congress.

Philadelphia, Sept. 27th, 1876.

JOHN L. CAMPBELL, Secretary. A. T. GOSHORN, Director General. JOS. R. HAWLEY, President.

The Arlington Mills had hardly fairly started in the manufacture of these goods, — the luster, or hard-finished fabrics known as alpacas, poplins, etc., — before the fashion which decreed their popularity began to change. They were made of the long-haired or "luster" wool, commonly known as English wool, and largely raised in that country, where the manufacture of these fabrics attained a larger degree of success than attended it anywhere else. But with the decadence of crinoline there came into use the soft and clinging fabrics, at that time made principally from merino combing wools, which have since held the field against all innovation.

Changes of fashion.

It is impossible to exaggerate the gain to the people of the United States from the successful establishment of the worsted manufacture in this country. Up to a comparatively recent period, almost the entire supply of these goods worn by our mothers, wives, and daughters was imported from abroad. They were sold at prices which placed them beyond the reach of the poorer classes. The tariff legislation which permitted the rapid development of the manufacture has resulted in the investment of many millions of dollars in capital, and has given steady employment, at high wages, to many thousands of people. But quite as important and gratifying has been the effect upon the cost of these fabrics to the millions of our countrywomen who are now clad in them. Substantially all the cheaper grades of the cotton-warp dress-goods, and also the flannel dress-goods, now worn here are made here as well, and sold at prices in competition with which foreign manufacturers cannot export them. This industry is perhaps the most striking illustration of the enterprise and courage with which our manufacturers have seized upon every opportunity which the extension of adequate protection, by the tariff, has offered them, to enlarge the industries of the United States. One aspect of it, which has attracted the attention of medical men, is the effect in permitting the substitution of garments containing more or less of wool, for the cotton fabrics with which, for many years, the people of New England, notwithstanding its fickle and austere climate, were largely

Benefits of the new industry.

Cheaper clothing.

Warmer clothing.

clad. One writer says that "our graveyards are filled with the remains of men and women whose duration of life has fallen sadly short of that of an ancestry whose clothing was fabricated solely from wool, around the domestic hearth-stone."

There is still ample field for the further development of this branch of the worsted industry in the United States. There exists no adequate reason why practically the whole consumption of our people in this class of goods should not be made at home. Few people realize what this statement means; how much of additional capital, how many thousands of additional looms and operatives we require, in order to enable us to supply the entire home market. Until very recently, more of these goods were imported than we made at home. The importations for 1889 reached the enormous aggregate of 93,000,000 square yards, with a foreign value of nearly $20,000,000. This is equivalent to two and one-half square yards for every woman and girl in the country, and means that one in three of our female population wears a foreign-made dress. By the census of 1880, the total quantity of dress-goods made in this country was about 90,000,000 yards — not so many as we imported in 1889. The quantity of the home-made goods has largely increased in the ten years since passed, — how much we have no means of knowing, — but still the proportion of these goods imported, as compared with the home manufacture, continues to be vastly in excess of the proportion in any other branch of the wool manufacture. Nevertheless, our experience

Room for growth.

Imports of dress-goods.

The home production.

proves that we know how to make these goods, and can make them as well as the Bradford people. Neither in the matter of climate, nor in the relative skill of their operatives, do our foreign competitors possess any advantage which American ingenuity and enterprise cannot overcome. Nor are we ready to admit that even the French, whose present supremacy in this field we frankly concede, can surpass Americans in the ingenuity and artistic genius requisite to create new fabrics to meet the constantly changing demands of fashion.

VI.

THE PRODUCTS OF THE ARLINGTON WORSTED MILLS.

THE variety of the fabrics devised since the worsted manufacture reached its high state of development is so large as almost to defy cataloguing. Apparently there is no limit to the new variations of which it is susceptible. A single firm in Bradford has sent to America a list of worsted fabrics embracing over sixty distinct grades of goods. The list includes all the goods commonly known in the trade as delaines, cashmeres, brocades, Italian cloths, mousselines, bareges, grenadines, merinos, serges, bombazines, Henrietta cloths, etc.

Variety of worsted fabrics.

These names rarely possess any etymological significance, being usually given arbitrarily by the first introducer of the article, and frequently applied, with variations, to fabrics quite different from the originals, and especially to cheaper imitations.

The goods made by particular establishments are, however, well known to the trade by the designations which they apply.

THE WORSTED SPINNING MILL, FROM CHALMERS ST.

The products of the worsted department of the Arlington Mills now consist chiefly of ladies' dress-goods and worsted yarns.

Products of the Arlington.

The dress-goods have from the outset enjoyed a high reputation. The aim has always been a double one: first, to provide good fabrics for the masses at reasonable prices; and, second, to meet the wants of those who from habit or from prejudice have hitherto considered it impossible to purchase fabrics of American manufacture fit to wear, and so have depended wholly upon goods made abroad.

The Arlington cotton-warp, fancy high-colored plaids are regarded as among the best goods of the kind made in the United States, and have been sold in very large quantities.

Colored plaids.

The mills have also made a specialty of the manufacture of standard piece-dyed cashmeres. Their qualities "90," "100," "200," and "300" in these goods are well known in the most distant parts of the country. The trade has always appreciated the excellence of the alpacas, coat-linings, and Canton cloths made at these mills. Very fine and light specimens of the latter fabric, especially adapted to the wants of the rubber trade in the manufacture of gossamer waterproofs for ladies' wear, have been exceedingly popular. One feature of the management is its readiness, at any time, to make specialties on orders for peculiar fabrics.

Coat-linings and Canton cloths.

While striving to produce desirable medium-priced goods for general use, the Arlington began some years ago the manufacture of a fine quality of all-wool goods. Experiments in

this field, where the competition is with the most skilful and experienced of French manufacturers, who have commanded the American market from the beginning, have been costly, and at times of uncertain outcome. But perseverance has borne its legitimate fruit, here as elsewhere; and the fine and beautifully woven all-wool worsted goods which the Arlington has succeeded in placing on the market are believed to be the best goods of this description ever fabricated in this country, and they will compare most favorably with the products of the Rheims looms. These goods already command a large sale, and are rapidly winning their way to public favor. The annual product of dress-goods of every description now aggregates about 15,000,000 yards.

All-wool goods.

The Arlington Mills has achieved its success by its persistent adhesion to the production of standard grades of goods, which have received the popular approval, and become well known to the trade and the public. But the management is always on the alert to detect new methods of appealing to the taste and promoting the comfort of all classes of the people in the whole field of fabrics known as worsted dress-goods.

New patterns.

But the weaving department of the Arlington Mills, even with the new machinery now added, has never equalled its spinning capacity; and for the last five or six years it has devoted a great deal of attention to the spinning of worsted yarns for sale. With the recent construction of still another spinning mill, and the introduction of the latest patterns of machinery for spinning by the

Worsted yarns for sale.

French system, its facilities for supplying worsted yarns of all the desired qualities have reached a point that renders it inferior to no establishment in the United States.

These yarns are now made in all the forms and qualities which are demanded by all the branches of the worsted manufacture. Yarns for cassimeres, coatings, and cloakings, supplied by the Arlington Mills, are now in regular use, with the most satisfactory results, by many of the most celebrated makers of goods for men's wear.

All varieties.

The knitters of hosiery and of Jersey cloths require certain grades of yarn which the mills have been eminently successful in supplying.

Hosiery yarns.

Braid, Saxony, and zephyr yarns are also specialties of the Arlington. In all these varieties experience proves their products to be equal in every respect to the best makes of imported yarns.

Zephyr yarns.

These yarns are made of wool ranging in fineness from fine Australian to coarse quarter-blood, and are furnished in the grease or in fast colors, either slubbing or skein-dyed, single or two-ply. They are shipped either in skeins, on spinning or twister bobbins, on small spools or on large dresser spools, according as customers may require.

The Arlington Mills yarns have met with such noteworthy success for reasons which reach to the special methods employed at every stage of their manufacture.

One of the most important features of successful manufacture of yarn of uniform grade is the buying and sorting of the wool.

Not only is it necessary to use great care in the purchase of wool to secure as close a uniformity as possible, but the sorting itself must be carefully done. We have already described the sorting-room, in which a body of the most skilful and experienced wool sorters is employed, with a large stock of the raw material always at command. The system here pursued enables the Arlington to produce a given grade of stock year in and year out, without practical differences in the grading of a given quality. This requires the carrying of a very large quantity of both unsorted and sorted wool at all times, so that the slightest variations of one purchase with another can be equalized, and practical uniformity obtained.

Care in selecting stock.

The utmost care must also be used in the washing of the wool, not only to save loss of material, but to produce uniform color, as well as softness and loftiness of staple. The experience of the Arlington in this department accords with that of the best spinners in England, who agree that a potash olive-oil soap is necessary to give the best results.

Washing.

The handling of fine Australian wool requires very superior carding and combing to produce the best results. The Arlington has been constantly improving its machinery, not only to produce the largest quantity per day, per comb, but also to secure the most perfect work attainable.

Carding and combing.

Special machinery has also been introduced for the production of colored yarns, slubbing dyed, which gives much the

most uniform and perfect shades, both for close matching in color and in fastness to light and soap. In consequence, the Arlington can now produce a fine colored worsted yarn, either two-ply or single, much superior in quality and coloring to a skein-dyed article, for almost any purpose. For knitting purposes, single worsted yarn requires to be perfectly made, and as free as possible from slubs and bunches. Special attachments on nearly all of the machinery, from the comb to the spinning-frame, have been provided in the Arlington Mills to avoid these common defects. The drawing machinery is of the latest patterns, with many improvements introduced by themselves. It is important, in producing a fine grade of yarn, that the draft shall not exceed what the staple is able to stand, and make a uniform article, as they have for their fine work nine different operations in the drawing, which, with the several doublings succeeding, make from comb to yarn on their "XXX" grade, over three million doublings; and if reckoned back as far as the cards, counting only four doublings on the comb, the number of doublings is over seven million two hundred and fifty thousand.

Colored yarns.

Superior machinery.

In both the drawing and spinning departments particular care is taken as to the class of help employed, as so much there depends upon the care and attention of the individual operative. In the drawing, the operatives are drilled to make nice, careful splicings, all the way from the gill-box to the spinning-frame. A very slight neglect in this matter of piecing on the gill-box may

Careful splicings.

show its defect for a long distance in the yarn produced. The spinning-frames are also adapted to produce the finest counts of worsted yarn known to the trade, and here also the greatest care in the selection of help is necessary. On yarn made for sale, the doffers are not permitted, either in the spinning or twisting, to piece up an end.

Special provision for learners is made on work which can be followed through the mill in the several processes of manufacture, so that its defects may be noted and the proper remedies applied.

Twisting.

The twisting department is specially fitted up with a view to making yarn for sale, and the frames are constantly kept in perfect repair. A slight defect in the twister frame will produce serious results on the twisted yarn, and often for a long distance before it is discovered. Special attention has been given to the tying of knots, experience having proved that the weaver's knot is the only thing that can be depended upon for closeness and evenness.

Examination.

After the yarn is spun, twisted, and reeled, it has still to be examined. This is a feature to which the Arlington Mills owes its reputation as much, perhaps, as to any other. None of the twisted yarn, unless a customer specially asks that the examination be dispensed with, is sent from the mill without having every skein thoroughly examined, whether it is wound on bobbins or not. In this way defects which ought not to exist are detected and remedied, and many imperfections, such as are otherwise unavoidable, and would have to be left to customers to report, are thus removed.

VII.

THE FACTORY SYSTEM IN THE UNITED STATES.

THIS volume would be incomplete without some allusion to the help employed by the Arlington Mills, and the general subject of the influence of the factory system upon the people who are a part of it.

It is not unusual to read that the development of her textile manufactures has had an unfavorable influence upon the character of New England population, morally, physically, and intellectually. This impression has been strengthened by some accounts, recently printed, of the early New England factory life, in comparison with which there is claimed to be a distinct retrogression to-day. An interesting paper on "Early Factory Labor in New England from 1830 to 1848" appeared in the Annual Report of the Massachusetts Bureau of Labor Statistics for 1883. It is from the pen of Mrs. Harriet H. Robinson, who was herself an operative in one of the Lowell mills during this period. It is an

Early New England factory life.

Mrs. Harriet H. Robinson.

entertaining picture of a life, certain phases of which, it must be admitted, have almost wholly disappeared, — an idyllic sort of life, incident to the novelty of manufacturing under the factory system when new to this country, and quite unlike factory life as it exists to-day, anywhere in the world, outside of books.

Lowell was then but little more than a factory village. The cotton mills were new, or still constructing, and help was scarce and in great demand. Stories were told all over the country of the new factory place that was building, and of the fabulous wages that could there be earned. These stories reached the ears of the sons and daughters of the farmers and mechanics throughout New England, and they poured into the Yankee El Dorado, furnishing the basis of the original population of the town. They were from a class of people who do not now, as a rule, enter factory life. Many of them were educated; others worked at the loom in order to earn money wherewith to buy education, and still others left teaching for weaving, because they could command greater wages. Mrs. Robinson gives a quaint résumé of the antecedents of the people whom she found around her, "some of whom were the granddaughters of patriots who had fought at Bunker Hill, and had lost the family means in the war for independence." It was natural that such operatives should form literary circles, should edit newspapers like the "Lowell Offering," should hold their heads high, and should surround themselves with an atmosphere which is not often encountered in the Lawrence or Lowell of to-day. "The majority

The Yankee El Dorado.

THE ARLINGTON COTTON MILLS, REAR VIEW.

of them," says Mrs. Robinson, "were better born and better educated than their 'overlookers';" and as a consequence they were, she insists, better treated than they are to-day. Help was too valuable to be ill-treated, and this statement Mrs. Robinson makes with the emphasis of italics, implying that such is no longer the case in the New England factory towns.

Changed character of operatives.

Help is plentier now than it was then. Seldom a vacancy occurs without a crowd of applicants for it. The sons and daughters of the farmers no longer tend looms in summer and teach school in winter. The work in the mills is mostly done by a resident population, living in its own homes rather than in boarding-houses, as in early Lowell days. There is no glamor of romance about the work, nor are there many poets in the mills. But the change is not all for the worse, nor is it true, as Mrs. Robinson implies, that the lives of the modern operatives are "barren and hopeless," and their children on the road "to moral and physical destruction."

Not philanthropic institutions.

It is true that the modern manufacturing establishment is not conducted as a philanthropic institution. It is true that it is not a part of the regular duties of the management to exercise a protecting care and a parental influence over the operatives, as Mrs. Robinson thinks should be the case. Those duties and responsibilities the manufacturers generally leave to public and private philanthropy, precisely as do the men engaged in all other occupations which require the employment of large bodies of operatives. The change which Mrs. Robinson observes between factory life

now and forty years ago is due to causes of which she takes no cognizance, and is in no sense a retrograde change, or the subject of a legitimate criticism upon the manufacturer. The people now employed as operatives have come up and taken the places of those who formerly worked in the mills, and who now find occupations more agreeable and remunerative.

Increased comforts of life.

Our sterile New England now supports, by reason of its numerous factories, immense populations which were not here and could not have secured a livelihood here, at any wages, before the establishment of these factories. Not only has the number of occupations increased in consequence of these establishments, but the average incomes of the people have grown in an equal degree. There is as much comfort and plenty in the homes of the mill operatives in Massachusetts to-day as there used to be in the days before Lowell and Lawrence were founded, in the homes of the farmers throughout New England out of which came these intellectual spinners and weavers to whom Mrs. Robinson alludes. Compare them, home for home, comfort for comfort, life for life, and the balance will never fail to be with the mill operative of to-day, provided only that he or she be thrifty. They can afford to eat better food, to wear better clothes, and they will do more reading and have more carpets on the floors than did the average family in a like grade of life prior to the establishment of the factory system. Moreover, they have snug deposits in the savings banks, a modern luxury which their predecessors knew little about, for they lived from hand to mouth. This difference is due partly to increased

wages and partly to the increased purchasing capacity of the same amount of money. Mr. Edward Atkinson, the economist, has calculated that here in New England wages are twenty-five per cent. more than they were thirty and forty years ago, while the purchasing power of money is twenty-five per cent. greater than then. All this difference, equivalent to one-third of his earnings, and due to the successful establishment of the factory system among us, the operative of to-day either applies to his living expenses, thus raising the standard of comfort for all his family, or deposits in the savings bank.

Increased wages.

Nor is it easy to exaggerate the improvement in surroundings and the gain in opportunity of every description which time has brought to the mill operative. Schools are vastly better, libraries are more frequent and more accessible; every means of advancement is close at hand. What was once the exclusive privilege of the few has become more and more accessible to all.

Improved surroundings.

The greatest gain to the operative has come from the reduction in the hours of labor. They worked thirteen hours a day in the original New England mills, or seventy-eight hours a week. Now they work ten hours a day, or sixty hours a week. That eighteen hours a week, equivalent to ninety-three days a year of ten hours each, is added to the leisure of the operative, without deduction from his wage, to be utilized according to the inclination of each, but certainly not all of it to be wasted in frivolity and amusement. Mrs. Robinson tells us that the original Lowell

Reduced hours of labor.

operatives were not overworked, though their hours were long. "I have known a girl to sit twenty or thirty minutes at a time. They were not driven. They took their work-a-day life easy." This is quite an Acadian picture; but it does not accord with the general recollection of the manner in which things went in the first factories. Automatic machinery is so constructed and speeded as to require a fixed amount of labor or attention from those who operate it. As this machinery has been improved and simplified, more supervision can be intrusted to a single operative. Two or three looms can now be attended, where once an operative could tend but one. But it is not true that the work required of that single operative has increased in anything like the proportion of the increase in his product from the several machines; nor is it true that it is hard and exacting work, or that the operatives leave the factories at evening physically and mentally exhausted. Machinery permits the earning of wages with less of physical labor, and with less of skill, than was the case in the days when everything was done by handicraft. The field of labor has been constantly enlarging, while its recompense has increased and its toil is reduced by the development of mechanism as we see it in our factories to-day.

The work not exacting.

Another mighty gain to the operative is in the conditions under which he does his work. Sanitary and hygienic conditions were overlooked in the pioneer factories. Bad air, bad ventilation, insufficient heat, filthy surroundings, were inseparable from factory labor fifty years ago. We have described some of the improve-

Sanitary and hygienic conditions.

ments in these respects which are found in the Arlington Mills, and which are not peculiar to that mill. We have said that manufacturers realize that the best results accrue to them when they surround their operatives by the most favorable conditions for the promotion of health and activity. We have disclaimed the philanthropic motive in their behalf, in these advances and improvements; but it would not be fair to permit the inference to be drawn that they are either ignorant of or indifferent to the fact that there is a joint advantage in whatever conduces to the comfort, the contentment, and the health of their operatives.

There is, indeed, in every well-managed manufacturing establishment a certain *esprit*, a feeling of coöperation, between operatives and management, which is conducive to the most effective results. It must have its origin, on the part of the former, in the feeling that employers are doing the best that is possible for them, under existing conditions. This feeling ought to be strong enough to inspire a certain sense of loyalty, a desire to spin a smooth yarn, to weave a perfect cloth, to secure the best results from machinery, an emulation which permits the humblest employé to share in the pride which the success of the mill inspires in directors and stockholders. That this feeling is often missing cannot be denied; that strikes are of not infrequent occurrence in the textile industries is a fact of public notoriety; that friction is common in many mills where none of the machinery generates it, is true; and wherever these conditions exist, the loss that follows is shared by the operatives and by the owners alike. That being the case, it is quite as much for

Employers and employés.

the interest of one as of the other, that this spirit of coöperation and of loyalty should not be lacking. As a matter of good business, apart from the philanthropic phase of the question, the modern manufacturer considers these things, and does the best for his employés that close competition and uncertain markets will permit. It is an unquestioned fact that labor in American mills is not only better remunerated than in the mills of any other country, but is made up of better citizens, who lead happier lives in more comfortable homes, and that its children more frequently rise to higher stations in life. In all these respects, also, factory labor compares most favorably with any other occupation by which wages are earned in this country, and the factory town is the equal of other aggregations of people, in the public spirit, intelligence, and morals of its residents.

Factory life not demoralizing.

That factory life is not demoralizing to those engaged in it, that it does not blunt them mentally, morally, or physically, is the conclusion at which Col. Carroll D. Wright arrived in 1880, after a careful investigation which covered the whole New England field. He took up each count in the indictment against the system, and found each in turn unfounded. It necessitates the employment of women and children, but its tendency is not, as shown by experience, to destroy family ties, domestic habits, or the home. The extension to women of an occupation whereby they can contribute directly to the support of the family may be claimed to have helped to build up the home, rather than destroy it, because it adds to its comforts and removes the grinding poverty which makes of home a hell. Under

the careful regulations which modern laws have thrown around the employment of children, the evils which sprang from it in the early days of the factory system, particularly in England, have disappeared. Young children are now almost universally excluded from the factory, and where the age permits, the fact warrants Col. Wright's conclusion that they are much better off inside than outside the factory.

Carroll D. Wright's investigation.

Neither is employment in textile factories injurious to the health. This fact is demonstrated by the most elaborate statistics, by which the death-rate in factory towns is shown to be not exceptional, under the constantly improving surroundings to which allusion has been made. It has sometimes been said that the factory system leads to intemperance, unthrift, poverty, and immorality; but this assertion has ceased to be frequent; for familiarity with the social conditions prevailing in a town like Lawrence shows just the reverse to be the case.

Health.

On the other hand, the economic advantages which spring from the establishment of the factory system of manufacture, and which increase with its spread in the United States, are as far-reaching as civilization itself. They may be summed up in the increase of wages and production, and the decrease in the prices of goods produced — which comprise the *summum bonum* of social economy — not only to those directly employed, but to all classes of society and to all communities. Half a century ago Dr. Andrew Ure, in his treatise on the "Philosophy of Manufactures," sum-

Economic advantages.

marized the gain which has come to the world from the utilization of machinery in the factory system under these three heads: —

1st. It makes it possible to fabricate some articles which, otherwise, could not be fabricated at all.

2d. It enables an operative to turn out a greater quantity of work than he could before, — time, labor, and quality of work remaining constant.

3d. It effects a substitution of labor comparatively unskilled, for that which is more skilled.

Many writers have since discussed the question, but none of them have substantially improved this summary of the benefits of the factory system, save in one particular; namely, the increase in earnings which it permits to the individual operative, accompanied by a marked reduction in the physical exertion required of him to earn a livelihood.

Past and present wages.

The hand-loom weaver in the United States never earned more than fifty cents a day, and in earning that he was compelled to exert himself physically to a degree not approximated in the management of a power loom. The fact that labor comparatively unskilled can now do the work which formerly required an unusual dexterity possessed by but few, has vastly enlarged the opportunities for gainful occupation, correspondingly reducing poverty and pauperism. Mechanical skill still finds its ample employment — its field has also been enlarged and its earnings increased under the impetus of the better wage of the less dextrous classes.

The practical demonstration of these things may be studied

by any one who will take the trouble to pursue his inquiries among the good people of the thrifty, prosperous, growing, orderly, well-governed, and progressive city of Lawrence. Its population by the Eleventh Census is 44,654; and of this population at least 7,000 souls may be said to depend directly for their livelihood upon the Arlington Mills. The actual number employed by the corporation is now about 2,700, of whom 2,250 are in the worsted mills, and 450 in the cotton mills. The operatives are believed to be as well drilled in their various duties as any in the country, and they share in the pride which the corporation feels in these well-appointed mills, and which springs from the quality of the goods turned out with their assistance. It is no small part of the work of the business office to keep the record of this little army of operatives and arrange for their weekly payment. This branch of the work is under the charge of paymaster Charles Wainwright in the worsted mills, and of Thomas Eastham in the cotton mills.

Employés of the Arlington Mills.

Up to 1877 the Arlington Mills had been in the habit of paying its employés monthly, as was the custom with other manufacturing corporations throughout the State. Early in that year Mr. Wainwright called the Treasurer's attention to the advantages which he thought would result from the more frequent payment of wages. He urged that the employé who is paid only once a month is obliged to use his credit in obtaining his necessary supplies, thereby being compelled to pay more for them, and being tempted to get into debt. Accordingly, on July 1, 1877, the plan was

Weekly payments introduced.

adopted of paying every two weeks. This plan worked so well that on December 1 of the same year the system of weekly payments was adopted, and has since been in use, payments being made every Friday for the work done during the preceding week. The Arlington was the first corporation of any magnitude in the State to adopt this plan, which in 1885–6 was made compulsory by act of the Legislature.

The Arlington Coöperative Association.

While not in any way connected with the Arlington Mills as a corporation, it is not out of place to allude to the Arlington Coöperative Association, which was organized under the laws of Massachusetts in the year 1884 by a portion of the operatives in the Arlington Mills. For the first two or three years its membership was confined to the Arlington operatives, and it was officered mainly from the overseers and gentlemen connected with the counting-room of the mills, duly elected annually by ballot, but whose personal service was one of disinterested benefit. It soon became evident that the field of usefulness for such an association was too great to be thus confined, and the membership was thrown open to the general public under certain proper restrictions. While then the Association has ceased to be so directly of interest to the mill, there still remains such a large proportion of its operatives connected with it that its welfare continues to be of interest to the management.

The Association was organized to carry out the principles of coöperative distribution upon the plans originally adopted by the "Rochdale Pioneers" of England. From the very first the business has been conducted on the basis of absolute cash

transactions for sales, and practically cash purchases, thus limiting the uncertain elements of business to the smallest possible margin.

The capital of the Association is represented in shares of the par value of $5 each, but limited in ownership to 200 shares to one individual. This capital is permitted to earn a fixed rate of interest only, namely, five per cent., which rate may upon vote of the stockholders be reduced, but cannot be increased. Whatever profit there may be made in the business over and above the expense of running the Association, including this fixed rate of interest, after setting aside not less than ten per cent. (according to the law of the State) as a sinking-fund, is distributed quarterly among the purchasers from the Association on the basis of a percentage on the amount of purchases made. All persons who are purchasers are eligible for this dividend; but those who are not stockholders receive only one-half the rate of dividend which may be declared to stockholding purchasers. This stock is not transferable, except by permission of the Board of Directors. Indeed, such transfers are rendered unnecessary in practice by the provision of the constitution, which permits the surrender to the Association of any stock at its par value after notice, and the reissue of the same to proper applicants. The legal limit of this notice is thirty days, but such surrenders have always been accepted practically upon demand; and so long as this condition can be maintained, it is impossible for the value of the stock to be either more or less than par.

At the present time the Association has three stores, one, the main or central store, on Broadway, near the Arlington Mills,

and two branch stores, doing a general grocery business. It has also a dry-goods department in its Broadway store, and a large coal and wood yard near the track of the Boston & Maine Railroad.

The real estate of the Association is valued at about $18,000, and its share capital, $40,000. In addition to its regular business conducted by itself, it secures a trade with two boot and shoe firms and one clothing store in the interest of its members, by which a dividend of ten per cent. on all purchases is paid direct to the Association on such receipted bills as may be presented through it, the purchaser himself receiving the same rate of dividend at the end of the quarter on such purchase as though it were obtained directly from the Association itself. This is a feature which has also been long tried in England, and with marked success.

To give an idea of the small beginning and present increase in the business of this Association we annex a tabulated statement which explains its growth. It is a magnificent commentary upon the capacity for usefulness to the consuming public, and particularly to mill operatives, of associations for coöperative distribution. We believe it can be said that no other association in the United States has equalled this one in its rapidity of growth, its conservative and skilful management, and the confidence which it has received and merited from the public.

The present board of directors contains but few immediately connected with the Arlington Mills, but it is with some pleasure that we can trace the influence of Arlington men in its councils.

THE ARLINGTON COÖPERATIVE ASSOCIATION.

	No. stock-holders.	Capital stock at end of each year.[1]	Interest paid on capital stock.
First year, 1885	280	$3,557 36	$173 24
Second year, 1886	351	6,026 67	192 07
Third year, 1887	577	14,743 76	441 96
Fourth year, 1888	751	20,203 35	877 35
Fifth year, 1889	1,086	27,585 91	1,144 43
Sixth year, 1890	1,381	40,312 32	1,557 53
			$4,386 58

[1] Including instalments.

	Total sales.	Dividends paid on purchases.	Sinking-fund at end of each year.
First year, 1885	$38,194 94	$1,949 98	$476 58
Second year, 1886	45,384 94	3,118 40	1,200 00
Third year, 1887	70,970 27	5,145 38	2,150 00
Fourth year, 1888	105,644 81	6,680 71	3,061 50
Fifth year, 1889	141,007 36	9,235 82	4,408 64
Sixth year, 1890	184,753 23	12,132 07	6,517 79
	$585,955 55	$38,262 36	

Conclusion.

We have now brought our trip through the Arlington Mills to an end. It has been a very hurried one, and there are many by-paths to which we have not penetrated, and many interesting processes to which we have not even alluded. The reader who has followed us on the journey will not be able to spin worsted or cotton

yarn, as a reward for his patience, nor would we advise him to undertake the weaving of dress-goods on the strength of any knowledge this book may have imparted. We have had a different purpose in preparing it. Primarily, we have sought to preserve, in a permanent form, the history of a textile manufactory which may fairly claim to have conquered results entitling it to rank with other establishments whose records form part of the permanent memorials of the country to whose development they have contributed.

Beyond and above this purpose, however, has been the aim to make this narrative a contribution to the popular knowledge of one of the great and growing industries of our country; to a more general understanding of the magnitude and importance of this industry, as compared with others that engage our people; and to a wider appreciation of the difficulties overcome in its conduct, of the ability required to win success, and of the preëminent services which those who engage in it render to the public.

The Arlington Mills is typical of a large number of establishments throughout New England and the Middle States whose history closely resembles its own — which have attained prosperity only after vicissitudes often more trying than those we have narrated, whose projectors and proprietors have made many sacrifices and endured long probations. Similar establishments are gradually appearing in the West and the South; and wherever a new textile mill is founded, there, it is safe to say, the people will be the gainers in every way. Wherever and whenever a community can contribute to the increase of

these establishments, to their prosperity and their development, the seeds are sown for a harvest in which all the public shares.

No department of mechanical industry presents a more fascinating field of study than the textile manufactures. Nowhere has human ingenuity found such splendid play as in the perfecting of the machinery

> "which draws and spins a thread
> Without the tedious toil of needless hands."

Nowhere do there remain wider fields and more tempting opportunities for still further advance. No other industry comes quite so closely home to the people as that which has to do with the fabrication of the clothing they wear,—it is still the "household" industry in a wider sense than that in which the term was once applied. No other industry affords to so many who earn day's wages pleasanter or easier work at better remuneration, or under more congenial conditions. No other industry offers to the student of social and economic law a more fruitful or suggestive field of study. No other industry is better worth the while of the nation to maintain, to develop, and to diversify.

If the perusal of this little book shall help to bring these truths home and make them plain, the author will be well repaid.

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